## 2.7 Summary of Site Risks

This section summarizes the HHRA and ERA that have been performed at Site 3 and Site 21. The COCs associated with unacceptable site risk are identified, as well as the potentially exposed populations and exposure pathways of primary concern. A summary of the findings of the ERA is also presented. Based on the presence of unacceptable risks to current and future construction workers and future child residents, remedial action is being recommended for Sites 3 and 21 to reduce the risks.

### 2.7.1 Summary of Human Health Risk Assessment

The baseline HHRAs for Site 3 and Site 21 estimate what human health risks the sites pose if no action were taken. They provide the basis for taking action and identify the COCs and exposure pathways that need to be addressed by the respective remedial actions. This section of the ROD summarizes the approaches used and the results of the baseline risk assessments for Site 3 and Site 21. The HHRA covers identification of COCs (hazard assessment), exposure assessment, toxicity assessment, and risk characterization. Potential risks for both current and future site occupants are discussed. Key assumptions and uncertainties associated with the HHRA are also identified.

#### 2.7.1.1 Identification of Contaminants of Concern

This section identifies those contaminants associated with unacceptable risk at the site and that are the basis for the proposed remedial action. Although other contaminants were detected at the Sites 3 and 21, these COCs are the primary risk-driving contaminants. The data used in this risk assessment was deemed to be of sufficient quality and quantity for its intended use. The detection frequency, range of detected concentrations, and the exposure point concentrations (EPCs) for contaminants and media of concern are presented in Table 2-3 grouped by environmental medium.

**Table 2-3: Exposure Point Concentrations for COCs Detected at Sites 3 and 21**

| Media | Contaminant of Concern | Concentration Detected (mg/kg) | | Frequency of Detection | Dermal/Ingestion Exposure Point Concentration (mg/kg) [a] | Inhalation Exposure Point Concentration ($mg/m^3$) [a] | 2008 EPA Residential RSL (mg/kg) | 2008 EPA Industrial RSL (mg/kg) | BTV (mg/kg) |
|---|---|---|---|---|---|---|---|---|---|
| | | Min | Max | | | | | | |
| **Site 3** | | | | | | | | | |
| Surface Soil, Onsite – Direct Contact | Aroclor 1248 | 0.031 | 0.330 | 0.05 | 0.116 | n/a | 0.22 | 0.74 | n/a |
| | Aroclor 1254 | 0.038 | 0.520 | 0.16 | 0.112 | n/a | 0.22 | 0.74 | n/a |
| | Aroclor 1260 | 0.018 | 0.610 | 0.24 | 0.101 | n/a | 0.22 | 0.74 | n/a |
| | Benzo(a)anthracene | 0.400 | 0.400 | 0.03 | 0.400 | n/a | 0.15 | 2.1 | n/a |
| | Benzo(a)pyrene | 0.320 | 4.50 | 0.05 | 1.479 | n/a | 0.015 | 0.21 | n/a |
| | Benzo(b)fluoranthene | 0.330 | 11.0 | 0.05 | 4.863 | n/a | 0.15 | 2.1 | n/a |
| | Benzo(k)fluoranthene | 0.370 | 3.70 | 0.05 | 1.293 | n/a | 1.5 | 21 | n/a |
| | Indeno(1,2,3-cd)pyrene | 3.50 | 3.50 | 0.03 | 3.500 | n/a | 0.15 | 2.1 | n/a |
| | Dieldrin | 0.00069 | 0.044 | 0.16 | 0.006 | n/a | 0.03 | 0.11 | n/a |
| | Antimony | 9.9 | 316 | 0.71 | 43.75 | n/a | 31 | 410 | 63 |
| | Arsenic | 0.26 | 128 | 0.95 | 51.00 | n/a | 0.39 | 1.6 | 62 |
| | Cobalt | 4.2 | 31.7 | 0.76 | 12.03 | n/a | 23 | 300 | 29 |
| | Iron | 790 | 249,000 | 1.00 | 88,340 | n/a | 55,000 | 720,000 | 116,495 |
| | Lead | 6.2 | 3,750 | 1.00 | 1,382 | n/a | 400 | 800 | 166 |
| Surface Soil, Onsite – Indirect Contact (volatilization) | Benzo(b)fluoranthene | 0.330 | 11.0 | 0.05 | n/a | 1.23E–07 (Residential) 6.17E–08 (Worker) | 0.15 | 2.1 | n/a |
| | Dieldrin | 0.00069 | 0.044 | 0.16 | n/a | 1.64E–09 (Residential) 8.18E–10 (Worker) | 0.03 | 0.11 | n/a |
| Subsurface Soil, Onsite – Direct Contact | Aroclor 1248 | 0.031 | 0.330 | 0.04 | 0.086 | n/a | 0.22 | 0.74 | n/a |
| | Aroclor 1254 | 0.038 | 0.520 | 0.13 | 0.104 | n/a | 0.22 | 0.74 | n/a |
| | Aroclor 1260 | 0.018 | 9.40 | 0.24 | 1.224 | n/a | 0.22 | 0.74 | n/a |
| | Benzo(a)anthracene | 0.400 | 0.980 | 0.04 | 0.452 | n/a | 0.15 | 2.1 | n/a |
| | Benzo(a)pyrene | 0.320 | 4.50 | 0.04 | 1.026 | n/a | 0.015 | 0.21 | n/a |
| | Benzo(b)fluoranthene | 0.330 | 11.0 | 0.07 | 1.190 | n/a | 0.15 | 2.1 | n/a |

| Media | Contaminant of Concern | Concentration Detected (mg/kg) | | Frequency of Detection | Dermal/Ingestion Exposure Point Concentration (mg/kg) [a] | Inhalation Exposure Point Concentration ($mg/m^3$) [a] | 2008 EPA Residential RSL (mg/kg) | 2008 EPA Industrial RSL (mg/kg) | BTV (mg/kg) |
|---|---|---|---|---|---|---|---|---|---|
| | | Min | Max | | | | | | |
| Subsurface Soil, Onsite – Direct Contact (cont'd) | Benzo(k)fluoranthene | 0.370 | 3.70 | 0.04 | 0.932 | n/a | 1.5 | 21 | n/a |
| | Dibenzo(a,h)anthracene | 0.740 | 0.002 | 0.02 | 0.740 | n/a | 0.015 | 0.21 | n/a |
| | Indeno(1,2,3-cd)pyrene | 3.50 | 0.04 | 0.04 | 3.500 | n/a | 0.15 | 2.1 | n/a |
| | Dieldrin | 0.00069 | 0.059 | 0.20 | 0.009 | n/a | 0.03 | 0.11 | n/a |
| | Antimony | 9.9 | 316 | 0.73 | 40.34 | n/a | 31 | 410 | 63 |
| | Arsenic | 0.26 | 426 | 0.96 | 98.31 | n/a | 0.39 | 1.6 | 62 |
| | Cobalt | 3.4 | 31.7 | 0.80 | 11.20 | n/a | 23 | 300 | 29 |
| | Iron | 790 | 249,000 | 1.00 | 82,640 | n/a | 55,000 | 720,000 | 116,495 |
| | Lead | 6.2 | 3,750 | 1.00 | 1,174 | n/a | 400 | 800 | 166 |
| Subsurface Soil, Onsite – Indirect Contact (volatilization) | Benzo(b)fluoranthene | 0.330 | 11.0 | 0.07 | n/a | 3.74E–08 (Residential) 1.87E–08 (Worker) | 0.15 | 2.1 | n/a |
| | Dieldrin | 0.00069 | 0.059 | 0.20 | n/a | 2.40E–09 (Residential) 1.20E–09 (Worker) | 0.03 | 0.11 | n/a |
| **Site 21** | | | | | | | | | |
| Surface Soil, Onsite – Direct Contact | Dioxins, TEQ (ng/kg) | 0.464 | 135.7 | 1.00 | 92.65 | n/a | 3.8 | 30 | n/a |
| | Benzo(a)anthracene | 0.430 | 0.460 | 0.09 | 0.434 | n/a | 0.15 | 2.1 | n/a |
| | Benzo(a)pyrene | 0.041 | 1.30 | 0.09 | 0.849 | n/a | 0.015 | 0.21 | n/a |
| | Benzo(b)fluoranthene | 0.400 | 1.90 | 0.09 | 1.900 | n/a | 0.15 | 2.1 | n/a |
| | Dibenzo(a,h)anthracene | 0.130 | 0.130 | 0.04 | 0.130 | n/a | 0.015 | 0.21 | n/a |
| | Indeno(1,2,3-cd)pyrene | 0.270 | 0.610 | 0.09 | 0.320 | n/a | 0.15 | 2.1 | n/a |
| | Aluminum | 3,790 | 242,000 | 1.00 | 75,970 | n/a | 77,000 | 990,000 | 173,500 |
| | Antimony | 1.2 | 145 | 1.00 | 83.13 | n/a | 31 | 410 | 63 |
| | Copper | 2.2 | 12,300 | 1.00 | 5,148 | n/a | 3,100 | 41,000 | 72.2 |
| | Iron | 3,760 | 264,000 | 1.00 | 103,010 | n/a | 55,000 | 720,000 | 116,495 |

| Media | Contaminant of Concern | Concentration Detected (mg/kg) | | Frequency of Detection | Dermal/Ingestion Exposure Point Concentration (mg/kg) [a] | Inhalation Exposure Point Concentration ($mg/m^3$) [a] | 2008 EPA Residential RSL (mg/kg) | 2008 EPA Industrial RSL (mg/kg) | BTV (mg/kg) |
|---|---|---|---|---|---|---|---|---|---|
| | | Min | Max | | | | | | |
| Surface Soil, Onsite – Indirect Contact (volatilization) | Benzo(b)fluoranthene | 0.400 | 1.90 | 0.09 | n/a | 6.35E–08 (Residential) 3.18E–08 (Worker) | 0.15 | 2.1 | n/a |
| Subsurface Soil, Onsite – Direct Contact | Dioxins, TEQ | 0.464 | 202.7 | 1.00 | 117.7 | n/a | 4.5E-06 | 1.8E-05 | n/a |
| | Benzo(a)anthracene | 0.430 | 0.460 | 0.09 | 0.434 | n/a | 0.15 | 2.1 | n/a |
| | Benzo(a)pyrene | 0.041 | 1.30 | 0.09 | 0.849 | n/a | 0.015 | 0.21 | n/a |
| | Benzo(b)fluoranthene | 0.400 | 1.90 | 0.09 | 1.900 | n/a | 0.15 | 2.1 | n/a |
| | Dibenzo(a,h)anthracene | 0.130 | 0.130 | 0.04 | 0.130 | n/a | 0.015 | 0.21 | n/a |
| | Indeno(1,2,3-cd)pyrene | 0.270 | 0.610 | 0.09 | 0.320 | n/a | 0.15 | 2.1 | n/a |
| | Aluminum | 3,790 | 242,000 | 1.00 | 88,340 | n/a | 77,000 | 990,000 | 173,500 |
| | Antimony | 1.2 | 145 | 1.00 | 95.21 | n/a | 31 | 410 | 63 |
| | Copper | 2.2 | 12,300 | 1.00 | 5,756 | n/a | 3,100 | 41,000 | 72.2 |
| | Iron | 3,760 | 264,000 | 1.00 | 71,700 | n/a | 55,000 | 720,000 | 116,495 |
| Subsurface Soil, Onsite – Indirect Contact (volatilization) | Benzo(b)fluoranthene | 0.400 | 1.90 | 0.09 | n/a | 6.35E–08 (Residential) 3.18E–08 (Worker) | 0.15 | 2.1 | n/a |

$mg/m^3$ milligram per cubic meter of air
ng/kg nanogram per kilogram
n/a not available

[a] The 95 percent upper confidence limits (of the mean) were used to evaluate direct exposures routes, such as incidental ingestion and dermal contact. However, in order to evaluate exposure through inhalation of contaminant vapors in indoor air, the EPCs were used to give the most accurate representation of site conditions. To estimate the potential exposure to volatile contaminants in an indoor setting, EPA's Johnson and Ettinger Model (EPA 2007) was used to estimate the EPCs.

#### 2.7.1.2 Exposure Assessment

This section documents the populations and exposure pathways that were quantitatively evaluated in the risk assessment. A conceptual site model (CSM) was developed to aid in determining reasonable exposure scenarios and pathways of concern. The CSM for Site 3 is shown on Figure 8, and the CSM for Site 21 is shown on Figure 9. As described in this section, both current and future populations have been evaluated based on current and reasonably anticipated future land use. The contaminated media to which people may be exposed is also discussed.

A conceptual exposure model was developed to depict the potential relationship or exposure pathway between contaminant sources and receptors. An exposure pathway describes the means by which a receptor can be exposed to contaminants in environmental media.

The primary purpose of the CSM is to structure the HHRA to determine whether exposure pathways are incomplete (requiring no further evaluation) or potentially complete requiring further evaluation. Only potentially complete exposure pathways are evaluated quantitatively in the risk assessment, which is consistent with EPA guidance (EPA 1989). A potentially complete exposure pathway must include all of the following elements before a quantitative assessment is performed:

- Sources and type of contaminants present
- Affected media (e.g., soil, soil gas)
- Contaminant release and transport mechanisms (e.g., spills, volatilization)
- Known and potential routes of exposure (e.g., ingestion, dermal contact, inhalation)
- Known or potential human receptors (e.g., residents, workers)

Site 3 is situated within an abandoned quarry, with steep walls on most sides. There are no plans to develop this site for residential use at anytime in the future. Because of restricted access and its industrial land use history, the possible human receptors include a maintenance worker, trespasser, and construction worker. Hunting of wild deer and pig takes place in the general area of Site 3. Therefore, ingestion of deer and wild pig meat by adults and children is a pathway of concern at the site. Potential risks from ingestion of deer and wild pig meat have been evaluated on a base-wide basis, and all risks were found to be below the EPA's risk targets of 1E–6 for cancer and HI equal to 1.0 for noncancer risks. These results are presented in the engineering evaluation/cost analysis report for IRP Site 16 (EA 1999b). Further, although any future residential development is not expected at this site, as a worst case scenario, residential adults and children were included in the risk assessment as populations of potential concern.

Site 21 is similarly situated within an abandoned quarry, with steep walls on most sides. It is overgrown and remote from active areas of the Base, and there are no plans to develop this site for residential use at anytime in the future. Because of restricted access and its industrial land use history, the possible human receptors include a maintenance worker, trespasser, and construction worker. At Site 21, there are designated hunting areas in the Northwest Field as near as 0.5 mile from the site. Wildlife may roam between the MSA and the unrestricted

(unfenced) areas of Northwest Field. Therefore, it is possible for human consumption of game meat, such as deer or pig that may have been exposed to Site 21 (see discussion above). Like Site 3, although any future residential development is not expected at this site, as a worst case scenario, residential adults and children were included in the risk assessment as populations of potential concern.

### 2.7.1.3 Toxicity Assessment

This section describes the carcinogenic and noncarcinogenic toxicity criteria used to calculate the potential risk for each COC. When available, these toxicity criteria are separated into ingestion, inhalation, and dermal routes of exposure. Also included is the source of the toxicity criteria and the primary health endpoint and organ of concern for each COC. Toxicity data for carcinogenic COCs detected at Site 3 or Site 21, for the dermal and ingestion pathway is presented in Table 2-4 and for the inhalation pathway in Table 2-5. Toxicity data for non-carcinogenic COCs detected at Site 3 or Site 21 is presented in Table 2-6.

**Table 2-4: Carcinogenic Toxicity Information for the Ingestion, Dermal Pathway**

| Contaminant of Concern | Cancer Slope Factors (mg/kg-day) | | Weight of Evidence/ Cancer Guideline Description | Source | Date |
|---|---|---|---|---|---|
| | Oral | Dermal | | | |
| Aroclor 1248 | 2.00E+00 | 2.00E+00 | B2 | IRIS | 2008 |
| Aroclor 1254 | 2.00E+00 | 2.00E+00 | B2 | IRIS | 2008 |
| Aroclor 1260 | 2.00E+00 | 2.00E+00 | B2 | IRIS | 2008 |
| Arsenic [a] | 1.50E+00 | 1.50E+00 | A | IRIS | 2008 |
| Benzo(a)anthracene | 7.30E–01 | 7.30E–01 | B2 | NCEA/PRG [b] | 2008 |
| Benzo(a)pyrene | 7.30+00 | 7.30+00 | B2 | IRIS | 2008 |
| Benzo(b)fluoranthene | 7.30E–01 | 7.30E–01 | B2 | NCEA/PRG [b] | 2008 |
| Benzo(k)fluoranthene | 7.30E–02 | 7.30E–02 | B2 | NCEA/PRG [b,c] | 2008 |
| Dibenz(a,h)anthracene | 7.30E+00 | 7.30E+00 | B2 | NCEA/PRG [b] | 2008 |
| Indeno(1,2,3-cd)pyrene | 7.30E–01 | 7.30E–01 | B2 | NCEA/PRG [b] | 2008 |
| Cobalt | n/a | n/a | — | PPRTV/PRG [b,c] | 2008 |
| Dieldrin | 1.60E+01 | 3.2E+01 | B2 | IRIS | 2008 |
| Dioxins, total PCDD [c] | 1.30E+05 | 1.30E+05 | — | Cal/EPA/PRG [b] | 2008 |

Note: EPA Weight of Evidence Classification: Contaminants and other agents in the environment assessed by the EPA are classified into five groups based upon scientific evidence of carcinogenicity.

Group A = Human carcinogen.
Group B1 = Probable human carcinogen; limited evidence is not conclusive.
Group B2 = Probable human carcinogen; inadequate evidence is not conclusive.
Group C = Possible human carcinogen; limited evidence that it causes cancer in animals, but no human data is available.
Group D = Not classifiable as to human carcinogenicity.

| | |
|---|---|
| — | no data |
| Cal/EPA | California Environmental Protection Agency |
| IRIS | Integrated Risk Information System |
| mg/kg-day | milligram per kilogram per day |
| n/a | not available |
| NCEA | National Center for Environmental Assessment |
| PCDD | polychlorinated dibenzo-p-dioxin |
| PPRTV | Provisional Peer Reviewed Toxicity Values |

[a] Values listed are for inorganic arsenic.
[b] Value was obtained from the Region 9 PRGs (September 2008). These values are still considered provisional.
[c] Values listed are for 2,3,7,8-Tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD).

**Table 2-5: Carcinogenic Toxicity Information for the Inhalation Pathway**

| Contaminant of Concern | Inhalation Cancer Slope Factor (mg/kg-day) | Weight of Evidence/Cancer Guideline Description | Source | Date |
|---|---|---|---|---|
| Arsenic [a] | 1.51E+01 | A | IRIS | 2008 |
| Benzo(b)fluoranthene | 3.85E–01 | B2 | NCEA/PRG [b] | 2008 |
| Cobalt | 3.15E+01 | C | IRIS | 2008 |
| Dieldrin | 1.61E+00 | B2 | Cal/EPA/PRG [b] | 2008 |

Note: EPA Weight of Evidence Classification: Contaminants and other agents in the environment assessed by the EPA are classified into five groups based upon scientific evidence of carcinogenicity.
Group A = Human carcinogen.
Group B1 = Probable human carcinogen; limited evidence is not conclusive.
Group B2 = Probable human carcinogen; inadequate evidence is not conclusive.
Group C = Possible human carcinogen; limited evidence that it causes cancer in animals, but no human data is available.
Group D = Not classifiable as to human carcinogenicity.
[a] Values listed are for inorganic arsenic.
[b] Value was obtained from the Region 9 PRGs (September 2008). These values are still considered provisional.

**Table 2-6: Non-Cancer Toxicity Information for the Ingestion, Dermal Pathway**

| Contaminant of Concern | Chronic/ Subchronic | Oral RfD (mg/kg-day) | Dermal RfD (mg/kg-day) | Primary Target Organ | Source | Date |
|---|---|---|---|---|---|---|
| Aluminum | Chronic | 1.00E+00 | 1.00E+00 | Kidney, Nervous | PPRTV/ PRG [a] | 2008 |
| Antimony | Chronic | 4.00E–04 | 6.00E–05 | Cardiovascular, Eyes, Hematologic, Reproductive, Respiratory | IRIS | 2008 |
| Aroclor 1254 | Chronic | 2.00E–05 | 2.00E–05 | Alimentary Tract, Developmental, Endocrine, Eye, Hematologic, Immune, Reproductive, Skin | IRIS/PRG [b] | 2008 |
| Arsenic [b] | Chronic | 3.00E–04 | 3.00E–04 | Alimentary Tract, Cardiovascular, Developmental, Hematologic, Nervous, Skin | IRIS | 2008 |
| Cobalt | Chronic | 3.00E–04 | 3.00E–04 | Cardiovascular, Respiratory, Skin, Hearing | PPRTV/ PRG [a] | 2008 |
| Copper | Chronic | 4.00E–02 | 4.00E–02 | Alimentary Tract, Respiratory, Skin | PPRTV/ PRG [a] | 2008 |
| Dieldrin | Chronic | 5.00E–05 | 2.50E–05 | Alimentary Tract, Nervous | IRIS | 2008 |
| Dioxins, total PCDD | Chronic | 1.00E–09 | 1.00E–09 | Alimentary Tract, Developmental, Endocrine, Hematologic, Immune, Reproductive, Respiratory, Skin | ATSDR/ PRG [a,c] | 2008 |
| Iron | Chronic | 7.00E–01 | 7.00E–01 | Cardiovascular | PPRTV/ EPA 2008 | 2008 |

| Contaminant of Concern | Chronic/ Subchronic | Oral RfD (mg/kg-day) | Dermal RfD (mg/kg-day) | Primary Target Organ | Source | Date |
|---|---|---|---|---|---|---|
| Lead | Chronic | — | — | Alimentary Tract, Cardiovascular, Developmental, Hematologic, Immune, Kidney, Nervous, Reproductive | — | 2008 |

Note: EPA Weight of Evidence Classification: Contaminants and other agents in the environment assessed by the EPA are classified into five groups based upon scientific evidence of carcinogenicity.
Group A = Human carcinogen.
Group B1 = Probable human carcinogen; limited evidence is not conclusive.
Group B2 = Probable human carcinogen; inadequate evidence is not conclusive.
Group C = Possible human carcinogen; limited evidence that it causes cancer in animals, but no human data is available.
Group D = Not classifiable as to human carcinogenicity.
ATSDR Agency for Toxic Substances and Disease Registry
RfD reference dose
[a] Value was obtained from the Region 9 PRGs (September 2008). These values are still considered provisional.
[b] Values listed are for inorganic arsenic.
[c] Values listed are for 2,3,7,8-Tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD).

### 2.7.1.4 Risk Characterization

This section of the risk assessment combines the results of the exposure assessment with the toxicity criteria identified for the COCs. Carcinogenic risks and noncarcinogenic impacts for each COC are presented for all populations and media of interest, including both current and future land use settings. Cumulative risks for all relevant pathways and populations are also described. These risk estimates are summarized in the sections below and in Table 2-7 through Table 2-10. The results of the HHRA are interpreted within the context of the CERCLA acceptable risk range (or State requirements, whichever is appropriate).

The major uncertainties affecting the risk assessment are also presented in this section, including uncertainties related to sampling and analysis, environmental fate and transport modeling, the use of default exposure assumptions, and those associated with the toxicity criteria.

For carcinogens, risks are generally expressed as the incremental probability of an individual's likelihood of developing cancer over a lifetime as a result of exposure to the carcinogen. Excess lifetime cancer risk is calculated from the following equation:

$$\text{Risk} = \text{CDI} \times \text{SF}$$

Where:

Risk = a unitless probability (e.g., $2 \times 10^{-5}$) of an individual's likelihood of developing cancer

CDI = chronic daily intake averaged over 70 years (mg/kg per day [mg/kg-day])

SF = slope factor, expressed as $(\text{mg/kg-day})^{-1}$

**Table 2-7: Site 3 Risk Summary**

| Medium | COC | EPC (mg/kg) | Current/Future Occupational Worker | | | Current/Future Excavation/Construction Worker | | | Future Resident (Adult) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Ingestion & Dermal | Inhalation | Cumulative Risk | Ingestion & Dermal | Inhalation | Cumulative Risk | Ingestion & Dermal | Inhalation | Cumulative Risk |
| **Carcinogenic Risk** | | | | | | | | | | | |
| Surface Soil | Aroclor 1248 | 0.1163 | 1.56E–07 | N/A | 1.56E–07 | 1.52E–07 | N/A | 1.52E–07 | 5.25E–07 | N/A | 5.25E–07 |
| | Aroclor 1254 | 0.1115 | 1.50E–07 | N/A | 1.50E–07 | 1.46E–07 | N/A | 1.46E–07 | 5.03E–07 | N/A | 5.03E–07 |
| | Aroclor 1260 | 0.1005 | 1.35E–07 | N/A | 1.35E–07 | 1.32E–07 | N/A | 1.32E–07 | 4.54E–07 | N/A | 4.54E–07 |
| | Benzo(a)anthracene | 0.400 | 1.90E–07 | N/A | 1.90E–07 | 1.87E–07 | N/A | 1.87E–07 | 6.45E–07 | N/A | 6.45E–07 |
| | Benzo(a)pyrene | 1.479 | 7.01E–06 | N/A | 7.01E–06 | 6.92E–06 | N/A | 6.92E–06 | 2.38E–05 | N/A | 2.38E–05 |
| | Benzo(b)fluoranthene (dermal & ingestion) | 4.863 | 2.30E–06 | N/A | 2.31E–06 | 2.28E–06 | N/A | 2.28E–06 | 7.84E–06 | N/A | 7.84E–06 |
| | Benzo(b)fluoranthene (inhalation) [a] | 6.17E–08 | N/A | 5.51E–10 | | N/A | N/A | N/A | N/A | 7.07E–09 | |
| | Benzo(k)fluoranthene | 1.293 | 6.13E–08 | N/A | 6.13E–08 | 2.28E–06 | N/A | 2.28E–06 | 2.08E–07 | N/A | 2.08E–07 |
| | Indeno(1,2,3-cd)pyrene | 3.50 | 1.66E–06 | N/A | 1.66E–06 | 1.64E–06 | N/A | 1.64E–06 | 5.64E–06 | N/A | 5.64E–06 |
| | Dieldrin (dermal & ingestion) | 0.00623 | 8.08E–08 | N/A | 8.09E–08 | 7.36E–08 | N/A | 7.36E–08 | 2.55E–07 | N/A | 2.55E–07 |
| | Dieldrin (inhalation) [a] | 8.18E–10 | N/A | 3.06E–11 | | N/A | N/A | N/A | N/A | 3.92E–10 | |
| | Arsenic | 51 | 3.20E–05 | N/A | 3.20E–05 | 3.85E–05 | N/A | 3.85E–05 | 1.31E–04 | N/A | 1.31E–04 |
| | Cobalt | 12.03 | 6.47E–09 | N/A | 6.47E–09 | 4.05E–09 | N/A | 4.05E–09 | 4.15E–08 | N/A | 4.15E–08 |
| Subsurface Soil | Aroclor 1248 | 0.0863 | 1.17E–07 | N/A | 1.17E–07 | 1.14E–07 | N/A | 1.14E–07 | 3.92E–07 | N/A | 3.92E–07 |
| | Aroclor 1254 | 0.104 | 1.40E–07 | N/A | 1.40E–07 | 1.36E–07 | N/A | 1.36E–07 | 4.69E–07 | N/A | 4.69E–07 |
| | Aroclor 1260 | 1.224 | 1.65E–06 | N/A | 1.65E–06 | 1.60E–06 | N/A | 1.60E–06 | 5.53E–06 | N/A | 5.53E–06 |
| | Benzo(a)anthracene | 0.452 | 2.14E–07 | N/A | 2.14E–07 | 2.12E–07 | N/A | 2.12E–07 | 7.29E–07 | N/A | 7.29E–07 |
| | Benzo(a)pyrene | 1.026 | 4.86E–06 | N/A | 4.86E–06 | 4.80E–06 | N/A | 4.80E–06 | 1.65E–05 | N/A | 1.65E–05 |

| Medium | COC | EPC (mg/kg) | Current/Future Occupational Worker | | | Current/Future Excavation/Construction Worker | | | Future Resident (Adult) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Ingestion & Dermal | Inhalation | Cumulative Risk | Ingestion & Dermal | Inhalation | Cumulative Risk | Ingestion & Dermal | Inhalation | Cumulative Risk |
| Subsurface Soil (cont'd) | Benzo(b)fluoranthene (dermal & ingestion) | 1.19 | 5.30E–07 | N/A | 5.30E–07 | 5.23E–07 | N/A | 5.23E–07 | 1.80E–06 | N/A | 1.80E–06 |
| | Benzo(b)fluoranthene (inhalation) [a] | 1.87E–08 | N/A | 1.67E–10 | | N/A | N/A | N/A | N/A | 2.14E–09 | |
| | Benzo(k)fluoranthene | 0.932 | 4.42E–08 | N/A | 4.42E–08 | 4.36E–08 | N/A | 4.36E–08 | 1.50E–07 | N/A | 1.50E–07 |
| | Dibenz(a,h)anthracene | 0.74 | 3.51E–06 | N/A | 3.51E–06 | 3.46E–06 | N/A | 3.46E–06 | 1.19E–05 | N/A | 1.19E–05 |
| | Indeno(1,2,3-cd)pyrene | 3.50 | 1.66E–06 | N/A | 1.66E–06 | 1.64E–06 | N/A | 1.64E–06 | 5.64E–06 | N/A | 5.64E–06 |
| | Dieldrin (dermal & ingestion) | 0.00914 | 1.19E–07 | N/A | 1.19E–07 | 1.08E–07 | N/A | 1.08E–07 | 3.73E–07 | N/A | 3.73E–07 |
| | Dieldrin (inhalation) [a] | 1.20E–09 | N/A | 4.48E–11 | | N/A | N/A | N/A | N/A | 5.75E–10 | |
| | Arsenic | 98.31 | 6.18E–05 | N/A | 6.18E–05 | 7.42E–05 | N/A | 7.42E–05 | 2.53E–04 | N/A | 2.53E–04 |
| | Cobalt | 11.2 | 6.02E–09 | N/A | 6.02E–09 | 3.77E–09 | N/A | 3.77E–09 | 3.86E–08 | N/A | 3.86E–08 |
| **Surface Soil Risk Total =** | | | | | **4.E–05** | N/A | N/A | **5.E–05** | N/A | N/A | **2E–04** |
| **Subsurface Soil Risk Total =** | | | | | **7.E–05** | N/A | N/A | **9.E–05** | N/A | N/A | **3E–04** |

N/A not applicable

[a] Measured in milligrams per cubic meter ($mg/m^3$).

**Table 2-8: Site 3 Non-Cancer Risk Summary**

| Medium | COC | EPC (mg/kg) | Non-Carcinogenic Hazard Quotient | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Current/Future Occupational Worker | | | Current/Future Excavation/Construction Worker | | | Future Resident (Adult) | | | Future Resident (Child) | | |
| | | | Ingestion & Dermal | Inhalation | Cumulative HI | Ingestion & Dermal | Inhalation | Cumulative HI | Ingestion & Dermal | Inhalation | Cumulative HI | Ingestion & Dermal | Inhalation | Cumulative HI |
| Surface Soil | Aroclor 1254 | 0.1115 | 1.05E–02 | N/A | 1.05E–02 | 2.56E–02 | N/A | 2.56E–02 | 1.19E–02 | N/A | 1.19E–02 | 9.92E–02 | N/A | 9.92E–02 |
| | Dieldrin | 0.00623 | 2.83E–04 | N/A | 2.83E–04 | 6.44E–04 | N/A | 6.44E–04 | 3.07E–04 | N/A | 3.07E–04 | 2.49E–03 | N/A | 2.49E–03 |
| | Antimony | 43.75 | 1.12E–01 | N/A | 1.12E–01 | 3.60E–01 | N/A | 3.60E–01 | 1.54E–01 | N/A | 1.54E–01 | 1.42E+00 | N/A | 1.42E+00 |
| | Arsenic | 51 | 1.99E–01 | N/A | 1.99E–01 | 5.98E–01 | N/A | 5.98E–01 | 2.61E–01 | N/A | 2.61E–01 | 2.36E+00 | N/A | 2.36E+00 |
| | Cobalt | 12.03 | 3.98E–02 | N/A | 3.98E–02 | 1.30E–01 | N/A | 1.30E–01 | 5.66E–02 | N/A | 5.66E–02 | 5.18E–01 | N/A | 5.18E–01 |
| | Iron | 88,341 | 1.24E–01 | N/A | 1.24E–01 | 4.09E–01 | N/A | 4.09E–01 | 1.74E–01 | N/A | 1.74E–01 | 1.62E+00 | N/A | 1.62E+00 |
| Sub-surface Soil | Aroclor 1254 | 0.104 | 9.77E–03 | N/A | 9.77E–03 | 2.38E–02 | N/A | 2.38E–02 | 1.11E–02 | N/A | 1.11E–02 | 9.24E–02 | N/A | 9.24E–02 |
| | Dieldrin | 0.00914 | 4.15E–04 | N/A | 4.15E–04 | 9.44E–04 | N/A | 9.44E–04 | 4.50E–04 | N/A | 4.50E–04 | 3.64E–03 | N/A | 3.64E–03 |
| | Antimony | 40.34 | 1.03E–01 | N/A | 1.03E–01 | 3.32E–01 | N/A | 3.32E–01 | 1.42E–01 | N/A | 1.42E–01 | 1.31E+00 | N/A | 1.31E+00 |
| | Arsenic | 98.31 | 3.84E–01 | N/A | 3.84E–01 | 1.15E+00 | N/A | 1.15E+00 | 5.03E–01 | N/A | 5.03E–01 | 4.54E+00 | N/A | 4.54E+00 |
| | Cobalt | 11.2 | 3.71E–02 | N/A | 3.71E–02 | 1.21E–01 | N/A | 1.21E–01 | 5.27E–02 | N/A | 5.27E–02 | 4.82E–01 | N/A | 4.82E–01 |
| | Iron | 82,644 | 1.16E–01 | N/A | 1.16E–01 | 3.82E–01 | N/A | 3.82E–01 | 1.62E–01 | N/A | 1.62E–01 | 1.51E+00 | N/A | 1.51E+00 |
| **Surface Soil Hazard Index Total =** | | | | | **5.E–01** | N/A | N/A | **2.E+00** | N/A | N/A | **7.E–01** | N/A | N/A | **6.E+00** |
| **Subsurface Soil Hazard Index Total =** | | | | | **7.E–01** | N/A | N/A | **2.E+00** | N/A | N/A | **9.E–01** | N/A | N/A | **8.E+00** |

N/A not applicable

**Table 2-9: Site 21 Risk Summary**

| Medium | COC | EPC (mg/kg) | Current/Future Occupational Worker | | | Current/Future Excavation/Construction Worker | | | Future Resident (Adult) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Ingestion & Dermal | Inhalation | Cumulative Risk | Ingestion & Dermal | Inhalation | Cumulative Risk | Ingestion & Dermal | Inhalation | Cumulative Risk |
| **Carcinogenic Risk** | | | | | | | | | | | |
| Surface Soil | Dioxins, TEQ [a] | 92.65 | 5.04E–06 | N/A | 5.04E–06 | 6.06E–06 | N/A | 6.06E–06 | 2.06E–05 | N/A | 2.06E–05 |
| | Benzo(a)anthracene | 0.434 | 2.06E–07 | N/A | 2.06E–07 | 2.03E–07 | N/A | 2.03E–07 | 7.00E–07 | N/A | 7.00E–07 |
| | Benzo(a)pyrene | 0.849 | 4.02E–06 | N/A | 4.02E–06 | 3.97E–06 | N/A | 3.97E–06 | 1.37E–05 | N/A | 1.37E–05 |
| | Benzo(b)fluoranthene (dermal & ingestion) | 1.90 | 9.01E–07 | N/A | 9.01E–07 | 8.89E–07 | N/A | 8.89E–07 | 3.06E–06 | N/A | 3.06E–06 |
| | Benzo(b)fluoranthene (inhalation) [b] | 3.18E–08 | N/A | 2.84E–10 | | N/A | N/A | N/A | N/A | 3.64E–09 | |
| | Dibenz(a,h)anthracene | 0.130 | 6.16E–07 | N/A | 6.16E–07 | 6.08E–07 | N/A | 6.08E–07 | 2.10E–06 | N/A | 2.10E–06 |
| | Indeno(1,2,3-cd)pyrene | 0.320 | 1.52E–07 | N/A | 1.52E–07 | 1.50E–07 | N/A | 1.50E–07 | 5.16E–07 | N/A | 5.16E–07 |
| Subsurface Soil | Dioxins, TEQ [a] | 117.7 | 6.41E–06 | N/A | 6.41E–06 | 7.69E–06 | N/A | 7.69E–06 | 2.62E–05 | N/A | 2.62E–05 |
| | Benzo(a)anthracene | 0.434 | 2.06E–07 | N/A | 2.06E–07 | 2.03E–07 | N/A | 2.03E–07 | 7.00E–07 | N/A | 7.00E–07 |
| | Benzo(a)pyrene | 0.849 | 4.02E–06 | N/A | 4.02E–06 | 3.97E–06 | N/A | 3.97E–06 | 1.37E–05 | N/A | 1.37E–05 |
| | Benzo(b)fluoranthene (dermal & ingestion) | 1.90 | 9.01E–07 | N/A | 9.01E–07 | 8.89E–07 | N/A | 8.89E–07 | 3.06E–06 | N/A | 3.06E–06 |
| | Benzo(b)fluoranthene (inhalation) [b] | 3.18E–08 | N/A | 2.84E–10 | | N/A | N/A | N/A | N/A | 3.64E–09 | |
| | Dibenz(a,h)anthracene | 0.130 | 6.16E–07 | N/A | 6.16E–07 | 6.08E–07 | N/A | 6.08E–07 | 2.10E–06 | N/A | 2.10E–06 |
| | Indeno(1,2,3-cd)pyrene | 0.320 | 1.52E–07 | N/A | 1.52E–07 | 1.50E–07 | N/A | 1.50E–07 | 5.16E–07 | N/A | 5.16E–07 |
| **Surface Soil Risk Total =** | | | | | **1.E–05** | N/A | N/A | **1.E–05** | N/A | N/A | **4E–05** |
| **Subsurface Soil Risk Total =** | | | | | **1.E–05** | N/A | N/A | **1.E–05** | N/A | N/A | **5E–05** |

N/A not applicable
[a] Measured in nanograms per kilogram (ng/kg).
[b] Measured in milligrams per cubic meter ($mg/m^3$).

**Table 2-10: Site 21 Non-Cancer Risk Summary**

| Medium | COC | EPC (mg/kg) | Non-Carcinogenic Hazard Quotient | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Current/Future Occupational Worker | | | Current/Future Excavation/Construction Worker | | | Future Resident (Adult) | | | Future Resident (Child) | | |
| | | | Ingestion & Dermal | Inhalation | Cumulative HI | Ingestion & Dermal | Inhalation | Cumulative HI | Ingestion & Dermal | Inhalation | Cumulative HI | Ingestion & Dermal | Inhalation | Cumulative HI |
| Surface Soil | Dioxins, TEQ [a] | 92.65 | 1.09E–01 | N/A | 1.09E–01 | 3.26E–01 | N/A | 3.26E–01 | 1.42E–01 | N/A | 1.42E–01 | 1.28E+00 | N/A | 1.28E+00 |
| | Aluminum | 75,968 | 7.85E–02 | N/A | 7.85E–02 | 2.52E–01 | N/A | 2.52E–01 | 1.20E–01 | N/A | 1.20E–01 | 1.01E+00 | N/A | 1.01E+00 |
| | Antimony | 83.13 | 2.12E–01 | N/A | 2.12E–01 | 6.84E–01 | N/A | 6.84E–01 | 2.92E–01 | N/A | 2.92E–01 | 2.71E+00 | N/A | 2.71E+00 |
| | Copper | 5,148 | 1.27E–01 | N/A | 1.27E–01 | 4.17E–01 | N/A | 4.17E–01 | 1.77E–01 | N/A | 1.77E–01 | 1.65E+00 | N/A | 1.65E+00 |
| | Iron | 103,013 | 1.45E–01 | N/A | 1.45E–01 | 4.77E–01 | N/A | 4.77E–01 | 2.02E–01 | N/A | 2.02E–01 | 1.89E+00 | N/A | 1.89E+00 |
| Sub-surface Soil | Dioxins, TEQ [a] | 117.7 | 1.38E–01 | N/A | 1.38E–01 | 4.14E–01 | N/A | 4.14E–01 | 1.81E–01 | N/A | 1.81E–01 | 1.63E+00 | N/A | 1.63E+00 |
| | Aluminum | 88,343 | 9.12E–02 | N/A | 9.12E–02 | 2.93E–01 | N/A | 2.93E–01 | 1.39E–01 | N/A | 1.39E–01 | 1.17E+00 | N/A | 1.17E+00 |
| | Antimony | 95.21 | 2.43E–01 | N/A | 2.43E–01 | 7.84E–01 | N/A | 7.84E–01 | 3.35E–01 | N/A | 3.35E–01 | 3.10E+00 | N/A | 3.10E+00 |
| | Copper | 5,756 | 1.42E–01 | N/A | 1.42E–01 | 4.66E–01 | N/A | 4.66E–01 | 1.98E–01 | N/A | 1.98E–01 | 1.84E+00 | N/A | 1.84E+00 |
| | Iron | 71,705 | 1.01E–01 | N/A | 1.01E–01 | 3.32E–01 | N/A | 3.32E–01 | 1.41E–01 | N/A | 1.41E–01 | 1.31E+00 | N/A | 1.31E+00 |
| **Surface Soil Hazard Index Total =** | | | | | **7.E–01** | N/A | N/A | **2.E+00** | N/A | N/A | **9.E–01** | N/A | N/A | **9.E+00** |
| **Subsurface Soil Hazard Index Total =** | | | | | **7.E–01** | N/A | N/A | **2.E+00** | N/A | N/A | **1.E+00** | N/A | N/A | **9.E+00** |

N/A not applicable

[a] Measured in nanograms per kilogram (ng/kg).

These risks are probabilities that usually are expressed in scientific notation (e.g., 1 x $10^{-6}$). An excess lifetime cancer risk of $1x10^{-6}$ indicates that an individual experiencing the reasonable maximum exposure (RME) estimate has a 1 in 1,000,000 chance of developing cancer as a result of site-related exposure. This is referred to as an "excess lifetime cancer risk" because it would be in addition to the risks of cancer individuals face from other causes such as smoking or exposure to too much sun. The chance of an individual's developing cancer from all other causes has been estimated to be as high as one in three. The EPA's generally acceptable risk range for site-related exposure is $10^{-4}$ to $10^{-6}$.

The potential for noncarcinogenic effects is evaluated by comparing an exposure level over a specified time period (e.g., life-time) with a reference dose (RfD) derived for a similar exposure period. An RfD represents a daily individual intake that an individual may be exposed to that is not expected to cause any deleterious effect. The ratio of site-related daily intake to the RfD is called a hazard quotient (HQ).

The HQ is calculated as follows:

$$\text{Non-cancer HQ} = \text{CDI/RfD}$$

Where:

CDI = chronic daily intake

RfD = reference dose

CDI and RfD are expressed in the same units and represent the same exposure period (i.e., chronic, subchronic, or short-term).

An HQ < 1 indicates that a receptor's dose of a single contaminant is less than the RfD, and that toxic noncarcinogenic effects from that contaminant are unlikely.

The HI is generated by adding the HQs for all COCs at a site that affect the same target organ (e.g., liver) or that act through the same mechanism of action within a medium or across all media to which an individual may reasonably be exposed. An HI < 1 indicates that adverse effects are unlikely from additive exposure to site contaminants. An HI > 1 indicates that site-related exposures may present a risk to human health.

*2.7.1.4.1 Risk Characterization, Site 3*

**Future Resident.** Under the RME scenario, the potential ILCR from all carcinogenic COCs in surface soil (0 to 2 ft bgs) is 2E–04 and in subsurface soil (0 to 10 ft bgs) is 3E–04 (see Table 2-7). The potential ILCRs are above the EPA target cancer risk range of 1E–06 to 1E–04. These risks are driven by direct exposure to soil with ingestion of soil being the main exposure pathway (approximately 86% and 88% of the surface and subsurface risk, respectively). Arsenic (approximately 76% and 85% for surface and subsurface soil, respectively) is the main risk driver. Arsenic was detected in the majority of samples collected (36 of 38 samples in surface soil and 43 of 45 samples in subsurface soil) with the highest detection of 426 mg/kg in subsurface soil. Of the samples with arsenic detections, all

but 1 exceeded the residential screening criteria (0.39 mg/kg), but only 3 detected samples exceeded the BTV (62 mg/kg).

Under the RME scenario, the HI for potential non-carcinogenic health effects from the COCs in surface soil is 6 for a hypothetical child resident and 0.7 for a hypothetical adult resident (Table 2-8). The HI from COCs in subsurface soil is 8 for a hypothetical child resident and 0.9 for a hypothetical adult resident. The child resident HIs are above the EPA target non-cancer value of 1. Non-cancer hazards are driven by soil ingestion (approximately 96%), including the ingestion of arsenic, iron, and antimony.

**Current and Future Excavation/Construction Worker.** Under the RME scenario, the potential ILCR for excavation/construction workers from all carcinogenic COCs in surface soil (0 to 2 ft bgs) is 5E–5 and in subsurface soil (0 to 10 ft bgs) is 9E–5 (Table 2-7). The potential ILCR is within the EPA target cancer risk range of 1E–06 to 1E-04. Much of these risks are due to direct exposure to soil with ingestion of soil being the main exposure pathway (approximately 87% and 89% of the surface and subsurface risk, respectively). Arsenic is the main risk driver (approximately 77% and 85% for surface and subsurface soil, respectively). Arsenic was detected in the majority of samples collected (36 of 38 samples in surface soil and 43 of 45 samples in subsurface soil) with the highest detection of 426 mg/kg in subsurface soil. All but 3 detections exceeded the industrial screening criteria (1.6 mg/kg); however, only three detected samples exceeded the BTV (62 mg/kg).

Under the RME scenario, the HI for potential non-carcinogenic health effects from the COCs in surface soil is 2 for an excavation/construction worker (Table 2-8). The HI from COCs in subsurface soil is also 2 for an excavation/construction worker. These HIs are above the EPA target non-cancer value of 1. Non-cancer hazards are driven by soil ingestion (approximately 95%), including the ingestion of arsenic, iron, and antimony.

**Occupational Worker.** Under the RME scenario, the potential ILCR for occupational workers from all carcinogenic COCs in surface soil (0 to 2 ft bgs) is 4E–5 and in subsurface soil (0 to 10 ft bgs) is 7E–5 (Table 2-7). The potential ILCRs are within the EPA target cancer risk range of 1E–06 to 1E–04. Much of these risks are due to direct exposure to soil with ingestion of soil being the main exposure pathway (approximately 75% and 78% of the surface and subsurface risk, respectively). Arsenic is the main risk driver (approximately 73% and 83% for surface and subsurface soil, respectively). Arsenic was detected in the majority of samples collected (36 of 38 samples in surface soil and 43 of 45 samples in subsurface soil) with the highest detection of 426 mg/kg in subsurface soil. Of the samples with arsenic detections, all but three samples exceeded the industrial screening criteria (1.6 mg/kg), but only three samples exceeded the BTV (62 mg/kg).

Under the RME scenario, the HI for potential non-carcinogenic health effects from the COCs in surface soil is 0.5 for an occupational worker (Table 2-8). The HI from COCs in subsurface soil is 0.7 for an occupational worker. These HIs are below the EPA target non-cancer value of 1.

*2.7.1.4.2 Risk Characterization, Site 21*

**Future Resident.** Under the RME scenario, the potential ILCR from all carcinogenic COCs in surface soil (0 to 2 ft bgs) is 4E–05 and in subsurface soil (0 to 10 ft bgs) is 5E–05 (Table 2-9). The potential ILCRs are within the EPA target cancer risk range of 1E–06 to 1E-04. These risks are driven by direct exposure to soil with ingestion of soil being the main exposure pathway (approximately 81% and 82% of the surface and subsurface risk, respectively). Dioxins/furans (TEQ) (approximately 51% and 57% for surface and subsurface soil, respectively) and benzo(a)pyrene (approximately 34% and 30% for surface and subsurface soil, respectively) are the main risk drivers. Dioxins/furans were detected in all the samples collected in both the surface and subsurface soil. However, benzo(a)pyrene was only detected in 2 of the 23 samples collected with concentrations of 1.3 mg/kg and 0.041 mg/kg, respectively. Both samples exceed the residential screening criteria (0.015 mg/kg).

Under the RME scenario, the HI for potential non-carcinogenic health effects from the COCs in surface soil is 9 for a hypothetical child resident and 0.9 for a hypothetical adult resident (Table 2-10). The HI from COCs in subsurface soil is 9 for a hypothetical child resident and 0.9 for a hypothetical adult resident. The child resident HIs are above the EPA target non-cancer value of 1. Non-cancer hazards are driven by soil ingestion (approximately 95%) of dioxin/furans, aluminum, antimony, copper, and iron.

**Current and Future Excavation/Construction Worker.** Under the RME scenario, the potential ILCR for excavation/construction workers from all carcinogenic COCs in surface soil (0 to 2 ft bgs) is 1E–05 and in subsurface soil (0 to 10 ft bgs) is 1E–05 (Table 2-9). The potential ILCRs are within the EPA target cancer risk range of 1E–06 to 1E–04. These risks are driven by direct exposure to soil with ingestion of soil being the main exposure pathway (approximately 82% and 83% of the surface and subsurface risk, respectively). Dioxins/furans (TEQ) (approximately 51% and 57% for surface and subsurface soil, respectively) and benzo(a)pyrene (approximately 33% and 29% for surface and subsurface soil, respectively) are the main risk drivers. Dioxins/furans were detected in all the samples collected in both the surface and subsurface soil. However, benzo(a)pyrene was only detected in 2 of the 23 samples collected with concentrations of 1.3 mg/kg and 0.041 mg/kg, respectively. Both samples are below the industrial screening criteria (0.21 mg/kg).

Under the RME scenario, the HI for potential non-carcinogenic health effects from the COCs in surface soil is 2 for an excavation/construction worker (Table 2-10). The HI from COCs in subsurface soil is 2 for an excavation/construction worker. The HIs are above the EPA target non-cancer value of 1. Non-cancer hazards are driven by soil ingestion (more than 95%) of dioxin/furans, aluminum, antimony, copper, and iron.

**Occupational Worker.** Under the RME scenario, the potential ILCR for excavation/construction workers from all carcinogenic COCs in surface soil (0 to 2 ft bgs) is 1E–05 and in subsurface soil (0 to 10 ft bgs) is 1E–05 (Table 2-9). The potential ILCRs are within the EPA target cancer risk range of 1E–06 to 1E–04. These risks are driven by direct exposure to soil with ingestion of soil being the main exposure pathway (approximately 67% and 69% of the surface and subsurface risk, respectively). Dioxins/furans (TEQ) (approximately 46% and 52% for surface and subsurface soil, respectively) and

benzo(a)pyrene (approximately 37% and 33% for surface and subsurface soil, respectively) are the main risk drivers. Dioxins/furans were detected in all the samples collected in both the surface and subsurface soil. However, benzo(a)pyrene was only detected in 2 of the 23 samples collected with concentrations of 1.3 mg/kg and 0.041 mg/kg, respectively. Both samples are below the industrial screening criteria (0.210 mg/kg).

Under the RME scenario, the HI for potential non-carcinogenic health effects from the COCs in surface soil is 0.7 for an occupational worker (Table 2-10). The HI from COCs in subsurface soil is 0.7 for an occupational worker. The HIs are below the EPA target non-cancer value of 1.

*2.7.1.4.3 Exposure to Lead*

An additional evaluation was conducted for exposure to lead. Lead was detected in the surface soils of Site 3 and Site 21. To provide site-specific evaluations of blood lead levels as they might relate to potential exposures to site-related surface soil, the California Environmental Protection Agency (Cal/EPA) "LeadSpread7" model was employed (Cal/EPA 2000). According to Cal/EPA, "LeadSpread 7 is the latest version of the California Department of Toxic Substances Lead Risk Assessment Spreadsheet. LeadSpread is a tool that can be used to estimate blood lead concentrations resulting from exposure to lead via dietary intake, drinking water, soil and dust ingestion, inhalation, and dermal contact."

The blood lead levels calculated for children potentially exposed to Site 3 soils exceeds the 10 µg/dL benchmark. Specifically, children potentially exposed to lead at the RME EPC of 1,382 mg/kg results in a calculated blood lead level of 43.5 µg/dL, well above the 10 µg/dL benchmark. Similarly, children potentially exposed to lead at the central tendency EPC of 1,174 mg/kg results in a calculated blood lead level of 19.3 µg/dL, a value in excess of the 10 µg/dL benchmark.

For Site 21, no calculated blood lead levels were found to exceed 10 µg/dL for any receptor; a level typically defined as a benchmark that should not be exceeded in 5% of the potentially exposed population.

2.7.1.5 Human Health Risk Assessment Conclusions

The HHRA performed for Site 3 identified carcinogenic COCs in surface and subsurface soil in excess of the EPA target cancer risk range for future adult residents, driven mostly by PAHs and arsenic. Non-cancer risk for resident adults, driven predominantly by antimony and arsenic, were below 1. The non-cancer HI for future child residents exceeded unity in surface soil by a factor of 8 and in subsurface soil by a factor of 10, due predominantly to antimony and arsenic. In addition to antimony, arsenic and PAHs, elevated concentrations of lead were detected in site soils above screening levels that yielded child blood lead values in excess of the EPA benchmark of 10 µg/dL.

At Site 21, the potential ILCR for future (or hypothetical) residents, excavation/construction workers, and occupational workers for both surface and subsurface soil are within the EPA target cancer risk range. The HIs for the child resident and excavation/construction worker

are above the EPA non-cancer target of 1, while the HIs for an adult resident and occupational worker are below the target value. Non-cancer hazards are driven by soil ingestion (approximately 95%) of dioxin/furans, aluminum, antimony, copper, and iron. While lead was detected above residential RSLs in surface soils, modeled blood lead levels were not found to exceed 10 µg/dL for any receptor.

### 2.7.2 Summary of Ecological Risk Assessment

The objective of the ERA was to evaluate possible risks to plants and wildlife associated with exposure to contaminants at Site 3 and Site 21. Ecological risks were estimated for each COC based upon a combination of the concentration and toxicity of the COC, the medium (e.g., soil or soil gas) in which the COC is found, estimated exposure rate and estimated exposure duration. These calculations were derived for several representative species that were observed, or may be present, at the IRP sites. The cumulative risk posed by the COCs at a particular site is called the HQ. The full ERA is presented in Appendix D of the RI report (AECOM 2010b). The ecological risks were assessed according to the EPA ERA guidance (EPA 1997).

In addition, measurement endpoints (measures of effects) corresponding to reduced growth/development, reproduction, and/or survival were identified for representative species observed, or expected to be present, at the sites being assessed. Exposure concentrations that produce adverse effects for growth/development, reproduction, or survival for plant and wildlife species were obtained from peer-reviewed publications. The no-observed-adverse-effect level was used to develop an exposure estimate below which adverse effects are not expected to occur. Ecological receptors selected for evaluation for each site include lower trophic level groups of plants and soil invertebrates, and two higher trophic level wildlife species—one bird (yellow bittern, *Ixobrychus sinensis*) and one mammal (house mouse, *Mus musculus*).

Selection of the bittern and mouse was based largely on the species' ecological importance and representativeness for the sites, and their habits that tend to lead to maximum exposure to soil pathways. Available soil benchmarks from the literature were used to assess potential effects for plants and soil invertebrates. Bittern-specific and mouse-specific ingestion doses for soil-related COC concentrations (i.e., ingestion doses for soil-based food items plus incidental soil ingestion) were used in conjunction with ingestion-dose toxicity reference values (TRVs) for birds and mammals, respectively, to derive soil benchmark concentrations (SBCs) for the bittern and mouse. The SBCs were calculated with the yellow bittern used to represent bird exposure, and the house mouse used to represent mammal exposure. The soil-based screening values for direct contact (plants and soil invertebrates) and food-chain exposure (bittern and mouse) were compared, and the lowest screening value for each contaminant was selected as the SBC for screening.

A comparison of the maximum detected surface soil concentration for each contaminant was made to the lowest SBC for each site contaminant. If the maximum concentration for a contaminant exceeded the screening value, the contaminant was retained for further evaluation; otherwise, the contaminant was eliminated as a site COC and dropped from further evaluation.

Contaminants identified as COCs at the end of the initial Tier 1 screening process were carried forward to a Tier 2 Step 3a baseline ecological risk assessment (BERA). The Step 3a BERA involves refining exposure assumptions made in the Tier 1 screen to arrive at a more accurate estimation of risk to the representative ecological receptors. The Navy incorporated the following refinements for exposure assumptions into the Step 3a efforts to estimate exposure and HQs:

- RME value for the EPC in estimating risk to ecological receptors is used. The RME is either the maximum concentration or the upper confidence limit (UCL) of the mean, whichever is lower.
- RME values are compared to site-specific background concentrations for metals.
- Body weights for the bittern and mouse are the means for the particular species. Body weights were minimum values in the Tier 1 screen to maximize exposure and better represent juvenile exposure.
- Food ingestion rates for the bittern and mouse are means for the particular species. Ingestion rates were maximum values in the Tier 1 screen to maximize estimates for contaminant intake.
- Diets for the yellow bittern and the house mouse include portions for plant material/seeds, soil invertebrates, and soil in the diets, each of which contains differing concentrations of a COC. The relative proportions of plant material (seeds, shoots), soil invertebrates, and incidental ingested soil in the diets are based on literature-derived values for the bittern and mouse.
- The site use factor (SUF) is the area of contamination at a site divided by the foraging area for a particular species. SUFs for the bittern and mouse were assumed to be 1 in the Tier 1 screen. In Tier 2, the following site areas were used to estimate SUFs for foraging areas identified for the bittern and mouse: Site 3 occupies 12 acres (4.86 hectares); and Site 21 occupies 5 acres (2.02 hectares). Foraging areas for the bittern and mouse were obtained from the scientific literature.

The following sections summarize ERA information for Step 3a BERA evaluations for each of two sites: Site 3 and Site 21. Guidance for preparing a ROD (EPA 1999) notes that the following details should be discussed for ERA in the ROD:

- Identification of COCs
- Exposure assessment
- Ecological effects assessment (including identification of assessment and measurement endpoints)
- Ecological risk characterization

For each of the sites, Sections 2.7.2.1 and 2.7.2.2 (Exposure Assessment and Ecological Effects Assessment, respectively) follow the same approach; therefore, common sections for these details are provided and are applicable to both sites. At the same time, Identification of

COCs and Ecological Risk Characterization are unique to each site; therefore, discussions for each of these details include subsections for each site.

#### 2.7.2.1 Exposure Assessment

Exposures for ecological receptors for each site address four assessment endpoints: plants, soil invertebrates, omnivorous birds, and omnivorous mammals. Exposures for all assessment endpoints are based on RME values for EPCs in surface soil. The RME is either the maximum concentration or the UCL of the mean, whichever is lower. Exposures for plants and soil invertebrates are based on the RME value. Exposures for birds and mammals are estimated for uptake of contaminants from soil into food items (plant material and soil invertebrates) and incidental ingestion of soil. Higher trophic level receptors for birds and mammals are represented by the yellow bittern and the house mouse, respectively.

##### *2.7.2.1.1 Ecological Habitats, Site 3*

Three principal habitat types were identified as occurring on or near Waste Pile 3 in the 1993 environmental impact statement for the proposed Guam National Wildlife Refuge (ICF 1998):

- Second-growth limestone forest
- *Leucaeana* (Tangantangan) forest
- Active Base

A more refined view of the site was obtained during the ecological survey of the site, which identified a mosaic of four ecological sub-habitat types as occurring at Site 3:

- Mixed shrub forest
- Mixed herbaceous vegetation
- *Pennisetum purpureum* (Elephant Grass) grassland
- Exposed bedrock/former quarry area

The first three habitats are considered "weed communities" and are characteristic of areas of physical disturbance (ICF 1998).

No sensitive habitats or significant (threatened or endangered) species were identified as occurring on, in, or near Site 3. There are no nearby wetland communities.

##### *2.7.2.1.2 Ecological Habitats, Site 21*

Site 21 is generally comprised of a second-growth limestone forest with sparse undergrowth beneath the canopy of taller emergent trees. While the Fire Tree (*H.-lago*) and Heritiera (*H. longipetiolata*) are two endangered tree species that have been observed within the Northwest Field, neither they nor any other known endangered or threatened species have been observed on the site. There are no nearby wetland communities.

### 2.7.2.2 Ecological Effects Assessment

Effects for plants and soil invertebrates are assessed by comparing measured concentrations of contaminants in soils to available effects-based soil benchmarks for plants and soil invertebrates. Effects for bird (e.g., yellow bittern) and mammal (e.g., house mouse) receptors are assessed by developing SBCs for the bittern and mouse for ingestion doses of soil-related COCs that are compared to ingestion dose TRVs for birds and mammals, respectively. No toxicity tests or field studies were performed.

The ERA and measurement endpoints for the Step 3a BERA for the two sites are summarized in Table 2-11.

**Table 2-11: Assessment and Measurement Endpoints for Step 3a BERA Considerations for Sites 3 and 21**

| Receptor of Concern | Exposure Pathway | Assessment Endpoint * | Testable Hypothesis | Measurement Endpoint | Data Available |
|---|---|---|---|---|---|
| Plants | Root uptake of contaminants in soil | Decrease in plant growth and reproduction | $H_0$: The concentration of contaminants in surface soil does not exceed a level known to be toxic to plants. | Compare RME surface soil concentration to risk-based SBC developed to protect plant growth and reproduction | Site-specific contaminant data for surface soil; for Step 3a BERA use RME value |
| Soil Invertebrates | Uptake of contaminants in soil | Decrease in growth and reproduction of soil invertebrates | $H_0$: The concentration of contaminants in surface soil does not exceed a level known to be toxic to soil invertebrates. | Compare RME surface soil concentration to risk-based SBC developed to protect growth and reproduction of soil invertebrates | Site-specific contaminant data for surface soil; for Step 3a BERA use RME value |
| Small omnivorous mammals (represented by the house mouse) | Ingestion of contaminants in soil, and accumulated in plant material and soil invertebrates | Protection and maintenance (survival, growth, and reproduction) of local omnivorous mammal populations | $H_0$: The ingestion of bioaccumulative contaminants in plant material, soil invertebrates, and surface soil does not exceed a level known to be toxic to small mammals. | Compare RME surface soil concentration of contaminant to risk-based Eco-SBC for mammals | Site-specific contaminant data for surface soil; for Step 3a BERA use RME value |

| Receptor of Concern | Exposure Pathway | Assessment Endpoint * | Testable Hypothesis | Measurement Endpoint | Data Available |
|---|---|---|---|---|---|
| Small omnivorous birds (represented by the yellow bittern) | Ingestion of contaminants in soil, and accumulated in plant material and soil invertebrates | Protection and maintenance (survival, growth, and reproduction) of local omnivorous bird populations | $H_0$: The ingestion of bioaccumulative contaminants in plant material, soil invertebrates, and surface soil does not exceed a level known to be toxic to small birds. | Compare RME surface soil concentration of contaminant to risk-based Eco-SBC for birds | Site-specific contaminant data for surface soil; for Step 3a BERA use RME value |

* Assessment endpoints identified for evaluation are based on the parameters used to derive toxicity benchmarks (see Measurement Endpoint column) and are not intended to imply measurement of these parameters in the field.
$H_0$ Null Hypothesis

In Tier 2, the potential risk to ecological receptors was estimated using the HQ methodology. Risk was estimated for each COC exposure pathway for representative bird and mammal species at each area of concern. A risk-management decision was made to place focus only on the risk associated with the upper trophic levels.

Exposure of birds and mammals in each area to COCs is determined based on the exposure characteristics of the yellow bittern and the house mouse, respectively. The exposure parameters used in Step 3a included the RME COC concentrations in soil and food species, mean receptor body weight, and mean receptor food intake.

The HQ is used to integrate toxicity and exposure information to predict possible adverse effects to ecological receptors. The method compares estimates of chronic daily intake of each COC at each site to the respective TRV. This comparison is expressed as the quotient (the HQ value) of the ratio of intake/TRV.

#### 2.7.2.3 Site 3

##### *2.7.2.3.1 Identification of Contaminants of Concern, Site 3*

COCs for ecological risk were measured in surface soil samples. For higher trophic level receptors of birds (i.e., yellow bittern) and mammals (i.e., house mouse), Step 3a BERA HQs exceed 1 for the bittern for four contaminants: chromium (HQ=2), lead (HQ=3), benzo(b)fluoranthene (HQ=5), and chrysene (HQ=6). Step 3a BERA HQs exceed 1 for the mouse for one contaminant: antimony (HQ=2). COCs for Site 3 are shown in Table 2-12.

##### *2.7.2.3.2 Ecological Risk Characterization, Site 3*

For the bittern, HQs exceed 1 for two metals (chromium and lead) and two organics (benzo[b]fluoranthene and chrysene), indicating a potential risk of adverse effects to birds.

However, comparison to background concentration ranges for site soils showed that chromium is present in soils at a concentration (EPC of 326 mg/kg) below the BTV (1,080 mg/kg) (Table 2-12). Therefore, chromium is removed as a COC. Lead (for the bird HQ=3) is present in soils at concentrations (EPC of 138 mg/kg) above its BTV (166 mg/kg).

However, the risk from lead exposure is based on the assumption of 100% bioavailability. The limestone-derived soils have a low hydrogen ion concentration; thus, the lead is likely to be present in a less bioavailable form (lead carbonate). Because of this and the low HQ, the risk to bird populations from exposure to site lead is assumed to be acceptable.

The presence of the two PAHs in site soils may represent a potential threat of adverse effects to birds. However, the exposure to these two PAHs is likely overestimated. Benzo(b) fluoranthene is detected in only 2 of 38 samples, and chrysene is detected in only 1 of 38 samples (Table 2-12). Because of the low frequency of detection in surface soils, it is unlikely that PAHs are present at concentrations high enough to cause unacceptable risk to birds.

For the house mouse, HQs exceed 1 for one metal (antimony), indicating a potential risk of adverse effects to mammals. However, the EPC (43.8 mg/kg) is below the BTV (63 mg/kg). Therefore, antimony is removed as a COC.

In summary, soils at Site 3 do not represent an unacceptable risk of adverse effects to birds or mammals represented by the yellow bittern and house mouse, respectively.

#### 2.7.2.4 Site 21

##### *2.7.2.4.1 Identification of Contaminants of Concern, Site 21*

COCs for ecological risk were measured in surface soil samples. For higher trophic level receptors of birds (i.e., yellow bittern) and mammals (i.e., house mouse), Step 3a BERA HQs for the bittern exceed 1 for chromium (HQ=3), copper (HQ=9), lead (HQ=2), and benzo(b)fluoranthene (HQ=3) and for the mouse exceed 1 for antimony (HQ=3), copper (HQ=4), and TCDD-TEQ (HQ=2). COCs for Site 21 are shown in Table 2-13.

##### *2.7.2.4.2 Ecological Risk Characterization, Site 21*

For the bittern, HQs exceed 1 for three metals (chromium, copper, and lead) and one organic compound (benzo[b]fluoranthene). For the house mouse, HQs exceed 1 for two metals (antimony and copper and one organic compound (tetrachlorodibenzo-p-dioxin-TEQ-mammal) (Table 2-13).

Although no HQs for either the bittern or mouse exceed 10 (the value deemed significant), the number of exceedances above 1 and above BTVs suggests that surface soils at Site 21 represent an unacceptable risk of adverse effects to birds and mammals represented by the yellow bittern and house mouse.

### 2.7.3 Basis for Action

The response actions selected in this ROD are necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances from these sites which may present a threat to public health, welfare, or the environment.

**Table 2-12: IRP Site 3 Contaminants of Potential Environmental Concern**

| Receptor | Contaminant Name | Number of Samples | Number of Detects | Background Concentration (mg/kg) | EPC | Units | L-TRV (mg/kg-day) | HQ |
|---|---|---|---|---|---|---|---|---|
| Yellow Bittern *Ixobrychus sinensis* | **SVOCs** | | | | | | | |
| | Bis(2-ethylhexyl)phthalate | 38 | 3 | N/A | 0.333 | mg/kg | 3.51 | 0.2 |
| | **PAHs** | | | | | | | |
| | Benzo(a)anthracene | 38 | 1 | N/A | 0.4 | mg/kg | 0.22 | 0.2 |
| | Benzo(a)pyrene | 38 | 2 | N/A | 1.48 | mg/kg | 0.22 | 0.7 |
| | Benzo(b)fluoranthene | 38 | 2 | N/A | 4.86 | mg/kg | 0.22 | 5 |
| | Benzo(g,h,i)perylene | 38 | 1 | N/A | 2.80 | mg/kg | 2.22 | 0.3 |
| | Benzo(k)fluoranthene | 38 | 2 | N/A | 1.29 | mg/kg | 0.22 | 1 |
| | Chrysene | 38 | 1 | N/A | 6.7 | mg/kg | 0.22 | 6 |
| | Fluoranthene | 38 | 2 | N/A | 0.691 | mg/kg | 2.22 | 0.01 |
| | Indeno(1,2,3-cd)pyrene | 38 | 1 | N/A | 3.5 | mg/kg | 0.22 | 0.6 |
| | Phenanthrene | 38 | 1 | N/A | 0.41 | mg/kg | 225 | 0.00006 |
| | **Pesticides** | | | | | | | |
| | 4,4' - DDE | 38 | 28 | N/A | 0.125 | mg/kg | 0.6 | 0.02 |
| | alpha-Chlordane | 38 | 5 | N/A | 0.00516 | mg/kg | 10.7 | 0.0002 |
| | Endrin | 38 | 2 | N/A | 0.00456 | mg/kg | 0.232 | 0.006 |
| | gamma-Chlordane | 38 | 9 | N/A | 0.00215 | mg/kg | 10.7 | 0.00006 |
| | **PCBs** | | | | | | | |
| | Aroclor-1254 | 38 | 6 | N/A | 0.112 | mg/kg | 0.88 | 0.04 |
| | Aroclor-1260 | 38 | 9 | N/A | 0.1 | mg/kg | * | * |
| | **Dioxins** | | | | | | | |
| | TCDD TEQ-birds | 5 | 1 | N/A | 0.000000326 | mg/kg | 0.000028 | 0.005 |
| | **Metals and Cyanide** | | | | | | | |
| | Antimony | 38 | 27 | 63 | 43.8 | mg/kg | * | * |
| | Arsenic | 38 | 36 | 62 | 51 | mg/kg | 22.4 | 0.05 |
| | Barium | 38 | 38 | 340 | 213 | mg/kg | 8.34 | 0.3 |
| | Beryllium | 38 | 30 | 3.30 | 15.5 | mg/kg | 10.1 | 0.01 |

| Receptor | Contaminant Name | Number of Samples | Number of Detects | Background Concentration (mg/kg) | EPC | Units | L-TRV (mg/kg-day) | HQ |
|---|---|---|---|---|---|---|---|---|
| Yellow Bittern *Ixobrychus sinensis (cont'd)* | Cadmium | 38 | 25 | 6.50 | 5.63 | mg/kg | 20 | 0.2 |
| | Chromium | 38 | 38 | 1,100 | 326 | mg/kg | 5 | 2 |
| | Cobalt | 38 | 29 | 29.00 | 12 | mg/kg | 76.1 | 0.002 |
| | Copper | 38 | 38 | 72.00 | 370 | mg/kg | 40.5 | 0.4 |
| | Cyanide | 38 | 3 | — | 1.81 | mg/kg | 10.4 | 0.07 |
| | Lead | 38 | 38 | 170 | 1,380 | mg/kg | 11.3 | 3 |
| | Manganese | 38 | 38 | 5,500 | 1,330 | mg/kg | 1,790 | 0.007 |
| | Mercury | 38 | 33 | 0.28 | 1.01 | mg/kg | 0.9 | 0.09 |
| | Nickel | 38 | 32 | 240 | 177 | mg/kg | 67.1 | 0.2 |
| | Silver | 38 | 20 | 15 | 2.79 | mg/kg | 20.2 | 0.02 |
| | Thallium | 38 | 24 | 1.40 | 0.447 | mg/kg | 0.511 | 0.07 |
| | Vanadium | 38 | 38 | 210 | 40.5 | mg/kg | 3.44 | 1 |
| | Zinc | 38 | 38 | 110 | 1,030 | mg/kg | 661 | 0.4 |
| House Mouse *Mus musculus* | **SVOCs** | | | | | | | |
| | Bis(2-ethylhexyl)phthalate | 38 | 3 | N/A | 0.333 | mg/kg | 190 | 0.002 |
| | **PAHs** | | | | | | | |
| | Benzo(a)anthracene | 38 | 1 | N/A | 0.4 | mg/kg | 6.15 | 0.007 |
| | Benzo(a)pyrene | 38 | 2 | N/A | 1.48 | mg/kg | 6.15 | 0.02 |
| | Benzo(b)fluoranthene | 38 | 2 | N/A | 4.86 | mg/kg | 6.15 | 0.1 |
| | Benzo(g,h,i)perylene | 38 | 1 | N/A | 2.80 | mg/kg | 6.15 | 0.07 |
| | Benzo(k)fluoranthene | 38 | 2 | N/A | 1.29 | mg/kg | 6.15 | 0.03 |
| | Chrysene | 38 | 1 | N/A | 6.7 | mg/kg | 6.15 | 0.2 |
| | Fluoranthene | 38 | 2 | N/A | 0.691 | mg/kg | 656 | 0.00009 |
| | Indeno(1,2,3-cd)pyrene | 38 | 1 | N/A | 3.5 | mg/kg | 6.15 | 0.02 |
| | Phenanthrene | 38 | 1 | N/A | 0.41 | mg/kg | 656 | 0.00008 |
| | **Pesticides** | | | | | | | |
| | 4,4' - DDE | 38 | 28 | N/A | 0.125 | mg/kg | 1.47 | 0.005 |
| | alpha-Chlordane | 38 | 5 | N/A | 0.00516 | mg/kg | 9.49 | 0.0001 |
| | Endrin | 38 | 2 | N/A | 0.00456 | mg/kg | 0.954 | 0.001 |

| Receptor | Contaminant Name | Number of Samples | Number of Detects | Background Concentration (mg/kg) | EPC | Units | L-TRV (mg/kg-day) | HQ |
|---|---|---|---|---|---|---|---|---|
| House Mouse *Mus musculus (cont'd)* | gamma-Chlordane | 38 | 9 | N/A | 0.00215 | mg/kg | 9.49 | 0.00005 |
| | **PCBs** | | | | | | | |
| | Aroclor-1254 | 38 | 6 | N/A | 0.112 | mg/kg | 0.673 | 0.03 |
| | Aroclor-1260 | 38 | 9 | N/A | 0.1 | mg/kg | 49.2 | 0.0004 |
| | **Dioxins** | | | | | | | |
| | TCDD TEQ-birds | 5 | 1 | N/A | 0.000000326 | mg/kg | * | * |
| | **Metals and Cyanide** | | | | | | | |
| | Antimony | 38 | 27 | 63 | 43.8 | mg/kg | 1.3 | 2 |
| | Arsenic | 38 | 36 | 62 | 51 | mg/kg | 1.31 | 0.7 |
| | Barium | 38 | 38 | 340 | 213 | mg/kg | 238 | 0.02 |
| | Beryllium | 38 | 30 | 3.30 | 15.5 | mg/kg | 5.32 | 0.02 |
| | Cadmium | 38 | 25 | 6.50 | 5.63 | mg/kg | 11.9 | 0.2 |
| | Chromium | 38 | 38 | 1,100 | 326 | mg/kg | 24 | 0.3 |
| | Cobalt | 38 | 29 | 29.00 | 12 | mg/kg | 24 | 0.004 |
| | Copper | 38 | 38 | 72.00 | 370 | mg/kg | 56 | 0.3 |
| | Cyanide | 38 | 3 | — | 1.81 | mg/kg | 813 | 0.02 |
| | Lead | 38 | 38 | 170 | 1,380 | mg/kg | 47 | 0.6 |
| | Manganese | 38 | 38 | 5,500 | 1,330 | mg/kg | 515 | 0.04 |
| | Mercury | 38 | 33 | 0.28 | 1.01 | mg/kg | 137 | 0.0007 |
| | Nickel | 38 | 32 | 240 | 177 | mg/kg | 17 | 0.5 |
| | Silver | 38 | 20 | 15 | 2.79 | mg/kg | 60 | 0.004 |
| | Thallium | 38 | 24 | 1.40 | 0.447 | mg/kg | 5.77 | 0.006 |
| | Vanadium | 38 | 38 | 210 | 40.5 | mg/kg | 5.9 | 0.3 |
| | Zinc | 38 | 38 | 110 | 1,030 | mg/kg | 192 | 1.0 |

* TRV is unavailable for listed contaminant; therefore, HQ is not calculated.
— Value is unavailable.
DDE dichlorodiphenyldichloroethylene
L-TRV lower threshold limit value
N/A not applicable

**Table 2-13: IRP Site 21, Contaminants of Potential Environmental Concern**

| Receptor | Contaminant Name | Number of Samples | Number of Detects | Background Concentration (mg/kg) | EPC | Units | L-TRV (mg/kg-day) | HQ |
|---|---|---|---|---|---|---|---|---|
| Yellow Bittern *Ixobrychus sinensis* | **SVOCs** | | | | | | | |
| | Bis(2-ethylhexyl)phthalate | 24 | 3 | N/A | 0.220 | mg/kg | 3.51 | 0.2 |
| | Diethylphthalate | 24 | 1 | N/A | 0.0890 | mg/kg | 1.11 | 0.1 |
| | Di-n-butylphthalate | 26 | 1 | N/A | 0.850 | mg/kg | 1.11 | 0.2 |
| | **PAHs** | | | | | | | |
| | Benzo(a)anthracene | 23 | 2 | N/A | 0.434 | mg/kg | 0.222 | 0.4 |
| | Benzo(a)pyrene | 23 | 2 | N/A | 0.849 | mg/kg | 0.222 | 0.6 |
| | Benzo(b)fluoranthene | 23 | 2 | N/A | 1.90 | mg/kg | 0.222 | 3 |
| | Benzo(g,h,i)perylene | 24 | 1 | N/A | 4.70 | mg/kg | 2.22 | 0.8 |
| | Benzo(k)fluoranthene | 23 | 2 | N/A | 0.282 | mg/kg | 0.222 | 0.4 |
| | Chrysene | 23 | 2 | N/A | 0.877 | mg/kg | 0.222 | 1 |
| | Dibenz(a,h)anthracene | 23 | 1 | N/A | 0.130 | mg/kg | 0.222 | 0.2 |
| | Indeno(1,2,3-cd)pyrene | 23 | 2 | N/A | 0.320 | mg/kg | 0.222 | 0.08 |
| | Pyrene | 23 | 2 | N/A | 3.10 | mg/kg | 2.22 | 0.08 |
| | **Dioxins** | | | | | | | |
| | TCDD TEQ-birds | 14 | 14 | N/A | 0.0000486 | mg/kg | 0.000028 | 1 |
| | **Metals and Cyanide** | | | | | | | |
| | Antimony | 27 | 27 | 63 | 83.1 | mg/kg | * | * |
| | Arsenic | 27 | 27 | 62 | 10.0 | mg/kg | 22.4 | 0.02 |
| | Barium | 27 | 27 | 340 | 116 | mg/kg | 8.34 | 0.3 |
| | Cadmium | 27 | 21 | 6.5 | 14.9 | mg/kg | 20.0 | 0.7 |
| | Chromium (Total) | 27 | 27 | 1,100 | 374 | mg/kg | 5.00 | 3 |
| | Cobalt | 27 | 20 | 29 | 8.12 | mg/kg | 76.1 | 0.002 |
| | Copper | 27 | 27 | 72 | 5,150 | mg/kg | 40.5 | 9 |
| | Lead | 27 | 27 | 170 | 457 | mg/kg | 11.3 | 2 |
| | Manganese | 27 | 27 | 5,500 | 2,890 | mg/kg | 1,790 | 0.02 |
| | Mercury | 27 | 9 | 0.28 | 0.201 | mg/kg | 0.900 | 0.03 |
| | Nickel | 27 | 27 | 240 | 65.7 | mg/kg | 67.1 | 0.1 |

| Receptor | Contaminant Name | Number of Samples | Number of Detects | Background Concentration (mg/kg) | EPC | Units | L-TRV (mg/kg-day) | HQ |
|---|---|---|---|---|---|---|---|---|
| Yellow Bittern *Ixobrychus sinensis (cont'd)* | Selenium | 27 | 12 | — | 1.09 | mg/kg | 2.90 | 0.05 |
| | Silver | 13 | 7 | 15 | 0.861 | mg/kg | 20.2 | 0.01 |
| | Thallium | 27 | 9 | 1.4 | 0.333 | mg/kg | 0.511 | 0.08 |
| | Vanadium | 27 | 27 | 210 | 33.7 | mg/kg | 3.44 | 1 |
| | Zinc | 27 | 27 | 110 | 723 | mg/kg | 661 | 0.4 |
| House Mouse *Mus musculus* | **SVOCs** | | | | | | | |
| | Bis(2-ethylhexyl)phthalate | 24 | 3 | N/A | 0.220 | mg/kg | 190 | 0.002 |
| | Diethylphthalate | 24 | 1 | N/A | 0.0890 | mg/kg | 47,500 | 0.000003 |
| | Di-n-butylphthalate | 26 | 1 | N/A | 0.850 | mg/kg | 1,900 | 0.00009 |
| | **PAHs** | | | | | | | |
| | Benzo(a)anthracene | 23 | 2 | N/A | 0.434 | mg/kg | 6.15 | 0.008 |
| | Benzo(a)pyrene | 23 | 2 | N/A | 0.849 | mg/kg | 6.15 | 0.01 |
| | Benzo(b)fluoranthene | 23 | 2 | N/A | 1.90 | mg/kg | 6.15 | 0.04 |
| | Benzo(g,h,i)perylene | 24 | 1 | N/A | 4.70 | mg/kg | 6.15 | 0.1 |
| | Benzo(k)fluoranthene | 23 | 2 | N/A | 0.282 | mg/kg | 6.15 | 0.006 |
| | Chrysene | 23 | 2 | N/A | 0.877 | mg/kg | 6.15 | 0.02 |
| | Dibenz(a,h)anthracene | 23 | 1 | N/A | 0.130 | mg/kg | 6.15 | 0.003 |
| | Indeno(1,2,3-cd)pyrene | 23 | 2 | N/A | 0.320 | mg/kg | 6.15 | 0.002 |
| | Pyrene | 23 | 2 | N/A | 3.10 | mg/kg | 6.15 | 0.04 |
| | **Dioxins** | | | | | | | |
| | TCDD TEQ-mammals | 14 | 14 | N/A | 0.0000927 | mg/kg | 0.000012 | 2 |
| | **Metals and Cyanide** | | | | | | | |
| | Antimony | 27 | 27 | 63 | 83.1 | mg/kg | 1.30 | 3 |
| | Arsenic | 27 | 27 | 62 | 10.0 | mg/kg | 1.31 | 0.1 |
| | Barium | 27 | 27 | 340 | 116 | mg/kg | 238 | 0.01 |
| | Cadmium | 27 | 21 | 6.5 | 14.9 | mg/kg | 11.9 | 0.5 |
| | Chromium (Total) | 27 | 27 | 1,100 | 374 | mg/kg | 24.0 | 0.3 |
| | Cobalt | 27 | 20 | 29 | 8.12 | mg/kg | 24.0 | 0.003 |
| | Copper | 27 | 27 | 72 | 5,150 | mg/kg | 56.0 | 4 |

| Receptor | Contaminant Name | Number of Samples | Number of Detects | Background Concentration (mg/kg) | EPC | Units | L-TRV (mg/kg-day) | HQ |
|---|---|---|---|---|---|---|---|---|
| House Mouse *Mus musculus (cont'd)* | Lead | 27 | 27 | 170 | 457 | mg/kg | 47.0 | 0.2 |
| | Manganese | 27 | 27 | 5,500 | 2,890 | mg/kg | 515 | 0.08 |
| | Mercury | 27 | 9 | 0.28 | 0.201 | mg/kg | 137 | 0.0001 |
| | Nickel | 27 | 27 | 240 | 65.7 | mg/kg | 17.0 | 0.2 |
| | Selenium | 27 | 12 | — | 1.09 | mg/kg | 1.43 | 0.1 |
| | Silver | 13 | 7 | 15 | 0.861 | mg/kg | 60.2 | 0.001 |
| | Thallium | 27 | 9 | 1.4 | 0.333 | mg/kg | 5.77 | 0.005 |
| | Vanadium | 27 | 27 | 210 | 33.7 | mg/kg | 5.90 | 0.3 |
| | Zinc | 27 | 27 | 110 | 723 | mg/kg | 192 | 0.7 |

* TRV is unavailable for listed contaminant; therefore, HQ is not calculated.
— Value is unavailable.
N/A not applicable

## 2.8 Remedial Action Objectives

Remedial action objectives (RAOs) are the criteria that need to be met by the selected remedy to be protective of human health and the environment. These goals typically serve as the design basis for the remedial alternatives that are presented in Section 2.9.

### 2.8.1 Remedial Action Objectives, Site 3

Based on the results of risk evaluation at Site 3, a response action is required.

The overall goal of the remedial action proposed for Site 3 is to protect occupational workers and possible future residents from potential exposure to surface and shallow subsurface soils containing COCs at concentrations that would pose an excess cancer risk (i.e., greater than 1E–04 to 1E–06), excess non-cancer risk (i.e., HI greater than 1), or risks associated with lead through direct contact, incidental ingestion, and/or inhalation of particulates.

Surface and shallow subsurface soils at Site 3 contain the metals antimony, arsenic, cobalt, and lead; PCBs; PAHs; and the pesticide dieldrin at concentrations that exceed screening levels (i.e., EPA RSLs). Specific RGs for Site 3 are to prevent exposure to contaminated surface and shallow subsurface soils containing these COCs thereby reducing or eliminating contaminant exposure to human receptors through dermal contact, ingestion, and inhalation of particulates. The RGs for Site 3 are noted in Table 2-14.

### 2.8.2 Remedial Action Objectives, Site 21

Based on the results of risk evaluations at Site 21, a response action is required at this site. The goals of the remedial action for Site 21 are: (1) allow for unrestricted use at the site by protecting future residents from potential exposure to surface and shallow subsurface soils containing COCs at concentrations that would pose an excess cancer risk or excess non-cancer risk through direct contact, incidental ingestion, and/or inhalation of particulates; and (2) to protect ecological receptors from exposure to surface and shallow subsurface soils containing COCs above ecological screening values.

Following implementation of the remedial action at Site 21, the post-remedy non-cancer risk would be below the HI of 1.0, the cancer risk would fall within the acceptable risk range of 1E–04 to 1E–06, and exposure to lead concentrations in soil above 800 mg/kg would be minimized.

**Table 2-14: Site-Specific COCs and RGs for Surface and Subsurface Soils, Site 3**

| Analyte | Receptor of Concern | EPA RSL [a] (Residential) (mg/kg) | EPA RSL [a] (Industrial) (mg/kg) | BTV [b] (mg/kg) | RG (mg/kg) |
|---|---|---|---|---|---|
| PAHs | | | | | |
| Benzo(a)anthracene | Resident Child and Adult | 0.150 | 2.1 | n/a | 0.150 |
| Benzo(a)pyrene | Resident Child and Adult | 0.0150 | 0.21 | n/a | 0.0150 |
| Benzo(b)fluoranthene | Resident Child and Adult | 0.150 | 2.1 | n/a | 0.150 |
| Benzo(k)fluoranthene | Resident Child and Adult | 1.50 | 21 | n/a | 1.50 |
| Dibenzo(a,h)anthracene | Resident Child and Adult | 0.0150 | 0.21 | n/a | 0.0150 |
| Indeno(1,2,3-c,d)pyrene | Resident Child and Adult | 0.150 | 2.1 | n/a | 0.150 |
| PCBs | | | | | |
| Aroclor 1248 | Resident Child and Adult | 0.220 | 0.74 | n/a | 0.220 |
| Aroclor 1254 | Resident Child and Adult | 0.220 | 0.74 | n/a | 0.220 |
| Aroclor 1260 | Resident Child and Adult | 0.220 | 0.74 | n/a | 0.220 |
| **Pesticides** | | | | | |
| Dieldrin | Resident Child and Adult | 0.030 | 0.11 | n/a | 0.0.0 |
| Metals | | | | | |
| Antimony | Resident Child and Adult | 31 | 410 | 63 | 63 |
| Arsenic | Resident Child and Adult | 0.39 | 1.6 | 62 | 62 |
| Cobalt | Resident Child and Adult | 23 | 300 | 29 | 29 |
| Lead | Resident Child and Adult | 400 | 800 | 166 | 400 |

n/a not available
[a] EPA, April 2009.
[b] Andersen AFB BTVs.

The RGs for Site 21 are to remediate contaminated surface and shallow subsurface soils containing PAHs, dioxins, antimony, and copper to RGs by reducing or eliminating contaminant exposure to future child residents and ecological receptors through dermal contact, ingestion, and inhalation of particulates. The RAOs are based on achieving unrestricted use of the site. The RGs for Site 21 are noted in Table 2-15.

**Table 2-15: Site-Specific COCs and RGs, Site 21**

| Analyte | Receptor of Concern | EPA RSL [a] (Residential) (mg/kg) | BTV [b] | RG [c] |
|---|---|---|---|---|
| **PAHs** | | | | |
| Benzo(a)anthracene | Resident Child and Adult | 0.150 | N/A | 0.150 |
| Benzo(a)pyrene | Resident Child and Adult | 0.0150 | N/A | 0.0150 |
| Benzo(b)fluoranthene | Avian, Resident Child and Adult | 0.150 | N/A | 0.150 |
| Dibenz(a,h)anthracene | Resident Child and Adult | 0.0150 | N/A | 0.0150 |
| Indeno(1,2,3-c,d)pyrene | Resident Child and Adult | 0.150 | N/A | 0.150 |
| **Dioxins and Furans** | | | | |
| Total EPA TEQs (WHO) [d] | Resident Child | 4.50E–06 | N/A | 4.50E–06 |
| **Metals** | | | | |
| Antimony | Resident Child | 31 | 63 | 63 |
| Copper | Resident Child | 3,100 | 72.2 | 3,100 |

N/A not applicable
WHO World Health Organization
[a] EPA 2009.
[b] Andersen AFB 2001.
[c] The RG for organic compounds is the EPA RSL. For metals, the RG is either the RSL or the BTV, whichever is higher.
[d] WHO Dioxin = TEQs (Van Den Berg et al. 2006).

## 2.9 Description of Alternatives

### 2.9.1 Description of Remedial Alternatives, Site 3

Six remedial technologies and processes were identified and screened for their potential application at Site 3 to contain, treat, or dispose of contaminated soil. The following remedial alternatives were considered:

- No action (screened to provide a baseline comparison)
- LUCs
- Excavation with onsite treatment
- Soil removal with offsite disposal
- Physical barriers (i.e., surface cap)
- Phytoremediation

Options range from no action to onsite treatment (i.e., stabilization and incineration) to removal of contaminated media. Some technologies, such as soil removal, would require that contaminated soil be transported to a CERCLA-approved facility.

The EPA developed a CERCLA guidance document for response actions that describes three criteria that should be evaluated for each technology during the preliminary screening process (EPA 1993). These criteria are effectiveness, implementability, and cost. The remedial technologies were evaluated using these three criteria. Two remedial technologies were eliminated from further consideration because they were rated as either ineffective, difficult to implement or very high in cost:

- **Excavation and removal of contaminated soil with onsite treatment.** The treatment options for metals would include stabilization or vitrification to immobilize the metals, and incineration for organic contamination. Due to the dual nature of the contamination (organic and inorganic), a treatment train approach incorporating both solidification/stabilization and incineration would be necessary. At Site 3, quantities of solid waste debris (asphalt, metal, concrete) would need to be removed from the soil prior to treatment and properly disposed of. Additionally, as contamination is widespread but heterogeneously disseminated and "hot spots" are not readily apparent, the total volume of soil to be excavated and treated may increase significantly based upon final delineation. While technically feasible, the cost would be very high. As a result, this alternative was eliminated from further consideration.
- **Phytoremediation.** Phytoremediation would involve the gradual removal of soil metals via uptake into plant roots and stems over a period of time, which are subsequently harvested and disposed of at the Andersen AFB Consolidation Unit. Presumably, multiple crops would be necessary to reduce soil metals concentrations to unrestricted use levels. At Site 3, contamination exists in both the surface and subsurface soil (the latter to depths exceeding 10 ft). Plant roots would not be effective at depths beyond a few ft bgs and, thus, would not be able to address contamination at depth; therefore, LUCs would still be required. As a result of these factors, this alternative was eliminated from further consideration.

Based on the preliminary screening, four remedial alternatives were retained for further consideration.

The retained alternatives are as follows:

- Alternative 1: No Action
- Alternative 2: LUCs
- Alternative 3: Soil Removal
- Alternative 4: Physical Barriers (containment)

The following sections describe the four remedial alternatives retained for detailed evaluation. The retained remedial alternatives are also summarized in Table 2-16.

#### 2.9.1.1 No Action Alternative

The no action alternative assumes that site conditions would be left in their current state. For this response alternative, the remaining contaminated soil and debris fill would be left in place and would continue to pose potential health risks to human and ecological receptors. No additional actions, such as LUCs (e.g., restrictive land use covenants, legal notices) or site monitoring would be implemented at the site. However, the no action alternative is only used to provide a baseline comparison with other alternatives being evaluated.

#### 2.9.1.2 Land Use Controls Alternative

The LUCs alternative includes institutional (legal) controls and engineering controls, such as signage. LUCs placed in Navy land use registries may include land use covenants (restricting site construction activities and land use to commercial / industrial only); notice of site contamination and land use restrictions; and Navy and EPA rights of access for purposes of SIs and further response action, if necessary. LUCs would require annual inspections, monitoring, and enforcement. Future actions associated with the LUC alternative are expected to be easily implemented, effective in protecting human health and the environment, and cost effective.

#### 2.9.1.3 Soil Removal

This alternative involves excavating site debris and soil contaminated with metals and organic compounds with concentrations above RGs, leaving the site safe for human receptors and allowing unrestricted use of the site. Excavated areas would be backfilled with clean, on-island soil and re-vegetated. For Site 3, total volume of media to be removed is estimated to be at least 13,000 cubic yards. As contamination is widespread and heterogeneously disseminated throughout the site, and "hot spots" are not readily apparent, the total volume of media to be removed might increase significantly based upon additional necessary delineation sampling.

Excavated contaminated media (solid waste debris and contaminated soil) would be disposed of at the Andersen AFB Consolidation Unit located at IRP Site 2, located less than 1/2 mile away. The Consolidation Unit is used to manage CERCLA waste. LUCs, long-term monitoring, and compliance reporting would not be required. This alternative could be easily implemented and would be effective in protecting human health and the environment; however, costs associated with extensive site excavation and contaminated soil transport and disposal could be high.

#### 2.9.1.4 Physical Barriers

The Physical Barriers alternative would involve installation of a cover to prevent exposure to contaminated soil by human and ecological receptors. The design of the physical barrier, such as a landfill cap, is site specific and depends on the intended functions of the system. At Site 3, a simple soil cover would be sufficient to eliminate direct exposure, as the lack of hazardous waste and general lack of more mobile soil contaminants do not necessitate the need for more advanced caps or barriers. It would also create a land surface that can support vegetation.

**Table 2-16: Common Elements and Distinguishing Features of Retained Alternatives, Site 3**

| | Alternative 1: No Action | Alternative 2: LUCs | Alternative 3: Soil Removal | Alternative 4: Physical Barriers |
|---|---|---|---|---|
| Key ARARs and TBCs associated with alternative | n/a | • EPA Residential RSLs (EPA 2009)<br>• Base-wide Ambient Metal Concentrations in Soil, Andersen AFB BTV (ICF 1997; Andersen AFB 2001)<br>• Department of Defense and Air Force Policy and Guidance on LUCs Associated with Environmental Restoration Activities for Active Installations (DoD 2001, AF 2003) | • EPA Residential RSLs (EPA 2009)<br>• Base-wide Ambient Metal Concentrations in Soil, Andersen AFB BTV (ICF 1997; Andersen AFB 2001)<br>• 40 CFR 262.11 - Hazardous Waste Determination | • EPA Residential RSLs (EPA 2009)<br>• Base-wide Ambient Metal Concentrations in Soil, Andersen AFB BTV (ICF 1997; Andersen AFB 2001)<br>• 40 CFR 262.11- Hazardous Waste Determination<br>• Department of Defense and Air Force Policy and Guidance on LUCs Associated with Environmental Restoration Activities for Active Installations (DoD 2001, AF 2003) |
| Long-term reliability of remedy | n/a | High | High | High |
| Quantity of untreated waste and treatment residuals to be disposed of off site or managed on site in a containment system | n/a | n/a | 13,500 (low risk) | 13,500 cy (low risk) |
| Estimated time for design and construction | n/a | n/a | < 1 year | < 1 year |
| Estimated time to reach remediation goals | n/a | 30 years | 1-2 years | 30 years |
| Estimated capital cost | $0 | $54,000 | $2,076,000 | $2,827,000 |
| Estimated annual O&M cost | $0 | $20,000 | $0 | $80,000 |
| Estimated total present worth | $0 | $794,000 | $2,075,000 | $5,794,000 |
| Discount rate | n/a | 2.7% | 2.7% | 2.7% |
| Number of years over which cost is projected | n/a | 30 | 1 | 30 |
| Use of presumptive remedies and/or innovative technologies | n/a | No | No | Yes<br>(Application of the CERCLA Municipal Landfill Presumptive Remedy to Military Landfills; EPA OSWER Directive No. 9355.0-67FS) |

CFR Code of Federal Regulations
n/a not available
TBC to be considered

Use of a soil cover would allow the contaminated soil and waste to remain in place. As such, it is easily implemented. However, as contaminated soil and waste remain in place, LUCs and monitoring would be necessary. In addition, the cap would require inspections, reviews, and maintenance, which is a long-term commitment to manage the site and ensure the integrity of the soil cover.

### 2.9.2 Common Elements and Distinguishing Features of Each Retained Alternative, Site 3

Table 2-16 provides a summary of the elements common to each alternative and features that distinguish one alternative from another.

### 2.9.3 Expected Outcome of Each Retained Alternative, Site 3

Table 2-17 provides a summary of the outcomes of each alternative.

**Table 2-17: Expected Outcome of Each Retained Alternative, Site 3**

| | Alternative 1: No Action | Alternative 2: LUCs | Alternative 3: Soil Removal | Alternative 4: Physical Barriers |
|---|---|---|---|---|
| Available uses of land upon achieving cleanup levels | n/a | Use restricted to commercial/industrial activities | Unrestricted Use | Use restricted to commercial/industrial activities |
| Time frame to achieve available land use | n/a | < 1 year | 1-2 years | < 1 year |
| Available uses of groundwater upon achieving cleanup levels | n/a [a] | n/a [a] | n/a [a] | n/a [a] |
| Time frame to achieve available groundwater use | n/a [a] | n/a [a] | n/a [a] | n/a [a] |
| Other impacts or benefits associated with alternative | n/a | None | Possible recolonization by native species | Reduction of ecological risk from installation of a soil cover |

n/a not available
[a] Groundwater is not addressed in this ROD.

### 2.9.4 Description of Remedial Alternatives, Site 21

Six remedial technologies and processes were initially identified and screened for their potential application at Site 21 to contain, treat, or dispose of contaminated soil. The following alternatives were considered:

- No action (screened to provide a baseline comparison)
- LUCs (legal and engineering controls)
- Excavation with onsite treatment
- Soil removal

- Physical barriers (i.e., surface cap)
- Phytoremediation

Options range from no action to onsite treatment (i.e., stabilization and incineration) to removal of contaminated media. Some technologies, such as offsite disposal, may require that contaminated soil be transported to a CERCLA-approved facility.

The remedial technologies were evaluated using the same three criteria used for Site 3: effectiveness, implementability, and cost. Three remedial technologies were eliminated from further consideration based on poor ratings in either effectiveness or implementability, or rated very high in cost:

- **Excavation and removal of contaminated soil with onsite treatment.** The treatment options for metals would include stabilization or vitrification to immobilize the metals, and incineration for organic contamination. Due to the dual nature of the contamination (organic and inorganic), a treatment train approach incorporating both solidification/stabilization and incineration would be necessary. At Site 21, quantities of solid waste debris (asphalt, metal, concrete) would need to be screened out from the soil prior to treatment and properly disposed of. Screening, management, and disposal of MEC would also be necessary. While technically feasible, the cost would be very high. As a result, this alternative was eliminated from further consideration.
- **Phytoremediation.** Phytoremediation would involve the gradual removal of PAHs and soil metals via uptake into plant roots and stems over a period of time, which would be subsequently harvested and disposed of at the Andersen AFB Consolidation Unit. The effectiveness of this treatment on dioxins is unknown. While the shallow nature of contamination would be amenable to this technology, multiple crops would be necessary to lower soil metals concentrations down to unrestricted use levels. Initial implementation would be easy. However, inspections, reviews, and maintenance would be necessary to check on plant growth and "weeding," and multiple crops would likely be required, necessitating a near-term commitment to manage the site. Ecological receptors would still be at risk during implementation of this remedy. As a result of these factors, this alternative was eliminated from further consideration.
- **LUCs.** The LUC alternative includes legal controls, and engineering controls, such as signage. LUCs placed in Navy land use registries may include land use covenants (restricting site construction activities and preventing residential use of the property.); notice of site contamination and land use restrictions; and Navy and EPA rights of access for purposes of site investigation and further response action, if necessary. While this alternative is easily implemented and effective in protecting human health, it does not address protection of ecological receptors. Therefore, this alternative was eliminated from further consideration.

Based on the preliminary screening, three remedial alternatives consisting of a combination of appropriate technologies were retained for further consideration.

The retained alternatives are as follows:

- Alternative 1: No Action
- Alternative 2: Soil Removal
- Alternative 3: Physical Barriers (containment)

The following sections describe the three remedial alternatives retained for detailed evaluation. The retained remedial alternatives are also summarized in Table 2-18.

#### 2.9.4.1 No Action Alternative

The no action alternative assumes that site conditions would remain in their current state. For this response alternative, existing contaminated soil would be left in place and continue to pose potential health risks to human and ecological receptors. No additional actions, such as LUCs (e.g., restrictive land use covenants, legal notices) or site monitoring would be implemented at the site. However, the no action alternative is only used to provide a baseline comparison with other alternatives being evaluated.

#### 2.9.4.2 Soil Removal

This alternative involves excavating soil contaminated with metals and dioxins with concentrations above RGs, reducing the risk of exposure for future residents and ecological receptors to acceptable levels and allowing unrestricted land use. Additional soil sampling would be necessary to delineate the extent of soil contamination and calculate the approximate volume of media to be removed prior to soil excavation (which is presently estimated at 3,700 cubic yards). Screening, management, and disposal of MEC would be necessary.

Excavated contaminated media (contaminated soil) would be disposed of at the Andersen AFB Consolidation Unit located at IRP Site 2, located approximately 4.3 miles away. The Consolidation Unit is used to manage CERCLA waste. LUCs, long-term monitoring, and compliance reporting would not be required. This alternative is easy to implement and would be effective in protecting human health and the environment; however, costs associated with extensive site excavation and contaminated soil transport and disposal could be high.

#### 2.9.4.3 Physical Barriers

The Physical Barriers alternative would involve installation of a cover to prevent exposure to contaminated soil by human and ecological receptors. The design of the physical barrier, such as a landfill cap, is site specific and depends on the intended functions of the system. At Site 21, a simple soil cover would be sufficient to eliminate direct exposure, as the lack of hazardous waste and general lack of more mobile soil contaminants do not necessitate the need for more advanced caps or barriers. It would also create a land surface that can support vegetation.

Use of a soil cover would allow the contaminated soil and waste to remain in place. As such, it is easily implemented. However, as contaminated soil and waste remain in place, LUCs

and monitoring would be necessary. In addition, the cap would require inspections, reviews, and maintenance, which is a long-term commitment to manage the site and ensure the integrity of the soil cover.

### 2.9.5 Common Elements and Distinguishing Features of Each Retained Alternative, Site 21

Table 2-18 provides a summary of the elements common to each alternative and features that distinguish one alternative from another.

**Table 2-18: Common Elements and Distinguishing Features of Retained Alternatives, Site 21**

| | Alternative 1: No Action | Alternative 2: Soil Removal | Alternative 3: Physical Barriers |
|---|---|---|---|
| Key ARARs and TBCs associated with alternative | n/a | • EPA Residential RSLs (EPA 2009)<br>• Base-wide Ambient Metal Concentrations in Soil, Andersen AFB BTV (ICF 1997, Andersen AFB 2001)<br>• 40 CFR 262.11-Hazardous Waste Determination<br>• Endangered Species Act (16 U.S.C 1531 and 50 CFR 200, 402) and Fish and Wildlife Coordination Act (16 U.S.C 661 and CFR 320 to 330) | • EPA Residential RSLs (EPA 2009)<br>• Base-wide Ambient Metal Concentrations in Soil, Andersen AFB BTV (ICF 1997, Andersen AFB 2001)<br>• 40 CFR 262.11-Hazardous Waste Determination<br>• Department of Defense and Air Force Policy and Guidance on LUCs Associated with Environmental Restoration Activities for Active Installations (DoD 2001, AF 2003) |
| Long-term reliability of remedy | n/a | High | High |
| Quantity of untreated waste and treatment residuals to be disposed of off site or managed on site in a containment system | n/a | 3,700 cy (low risk) | 3,700 cy (low risk) |
| Estimated time for design and construction | n/a | < 1 year | < 1 year |
| Estimated time to reach remediation goals | n/a | < 1 year | 30 years |
| Estimated capital cost | $0 | $468,000 | $517,000 |
| Estimated annual O&M cost | $0 | $0 | $20,000 |
| Estimated total present worth | $0 | $468,000 | $1,404,000 |
| Discount rate | n/a | 2.7% | 2.7% |
| Number of years over which cost is projected | n/a | 1 | 30 |

| | Alternative 1: No Action | Alternative 2: Soil Removal | Alternative 3: Physical Barriers |
|---|---|---|---|
| Use of presumptive remedies and/or innovative technologies | n/a | No | Yes (Application of the CERCLA Municipal Landfill Presumptive Remedy to Military Landfills; EPA OSWER Directive No. 9355.0-67FS) |

n/a not available

### 2.9.6 Expected Outcome of Each Retained Alternative, Site 21

Table 2-19 provides a summary of the outcomes of each alternative.

**Table 2-19: Expected Outcome of Each Retained Alternative, Site 21**

| | Alternative 1: No Action | Alternative 2: Soil Removal | Alternative 3: Physical Barriers |
|---|---|---|---|
| Available uses of land upon achieving cleanup levels | n/a | Unrestricted Use | Use restricted to commercial/industrial activities |
| Time frame to achieve available land use | n/a | < 1 year | < 1 year |
| Available uses of groundwater upon achieving cleanup levels | n/a [a] | n/a [a] | n/a [a] |
| Time frame to achieve available groundwater use | n/a [a] | n/a [a] | n/a [a] |
| Other impacts or benefits associated with alternative | n/a | Possible recolonization by native species | Reduction of ecological risk from installation of a soil cover |

n/a not available
[a] Groundwater is not addressed in this ROD.

## 2.10 Summary of Comparative Analysis of Alternatives

In accordance with the NCP, the alternatives for Site 3 and Site 21 were evaluated using the nine criteria described in Section 121(b) of CERCLA and the NCP Section (§) 300.430(f)(5)(i). These criteria are classified as threshold criteria, balancing criteria, and modifying criteria.

**Threshold criteria** are standards that an alternative must meet to be eligible for selection as a remedial action. There is little flexibility in meeting the threshold criteria—the alternative must meet them or it is unacceptable. The following are classified as threshold criteria:

- **Overall protection of human health and the environment.** Overall protection of human health and the environment addresses whether each alternative provides adequate protection of human health and the environment and describes how risks

posed through each exposure pathway are eliminated, reduced, or controlled, through treatment, engineering controls, and/or institutional controls.

- **Compliance with ARARs.** Section 121(d) of CERCLA and NCP § 300.430(f)(1)(ii)(B) require that remedial actions at CERCLA sites at least attain legally applicable or relevant and appropriate Federal and State requirements, standards, criteria, and limitations which are collectively referred to as "ARARs," unless such ARARs are waived under CERCLA section 121(d)(4).
  - **Applicable requirements** are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under Federal environmental or State environmental or facility citing laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site. State standards that are identified by a State in a timely manner and that are more stringent than Federal requirements may be applicable.
  - **Relevant and appropriate** requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under Federal environmental or State environmental or facility citing laws that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site (relevant) that their use is well-suited (appropriate) to the particular site. Only those State standards that are identified in a timely manner and are more stringent than Federal requirements may be relevant and appropriate.
  - Compliance with ARARs addresses whether a remedy will meet all of the ARARs of other Federal and State environmental statutes or provides a basis for invoking a waiver.

**Balancing criteria** weigh the tradeoffs between alternatives. These criteria represent the standards upon which the detailed evaluation and comparative analysis of alternatives are based. In general, a high rating on one criterion can offset a low rating on another balancing criterion. Five of the nine criteria are considered balancing criteria:

- **Long-term effectiveness and permanence.** Long-term effectiveness and permanence refers to expected residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time, once clean-up levels have been met. This criterion includes the consideration of residual risk that will remain on site following remediation and the adequacy and reliability of controls.
- **Reduction of toxicity, mobility, and volume through treatment.** Reduction of toxicity, mobility, or volume through treatment refers to the anticipated performance of the treatment technologies that may be included as part of a remedy.
- **Short-term effectiveness.** Short-term effectiveness addresses the period of time needed to implement the remedy and any adverse impacts that it may pose to

workers, the community, and the environment during construction and operation of the remedy until cleanup levels are achieved.

- **Implementability.** Implementability addresses the technical and administrative feasibility of a remedy from design through construction and operation. Factors such as availability of services and materials, administrative feasibility, and coordination with other governmental entities are also considered.
- **Cost.** This balancing factor assesses the costs of the remedial actions on the basis of present worth.

**Modifying criteria** are as follows:

- **Community acceptance.** This modifying factor accounts for the issues and concerns the public may have regarding each of the remedial actions. Factors of community acceptance to be discussed include features of the supportiveness, reservations, and opposition by the community. As with Territory Acceptance, the Community Acceptance criterion would be addressed after the public has had a chance to review and comment on the proposed remedial alternatives. Therefore, a public meeting is held to present each alternative in this ROD.
- **Territorial agency acceptance.** This modifying factor accounts for the technical and administrative issues and concerns the Territory may have regarding each of the remedial actions. The factors to be evaluated include features of the actions that the Territory supports, those it opposes, and those with which it has reservations. This factor would be addressed after the public has had a chance to review and comment on the proposed remedial alternatives.

### 2.10.1 Comparative Analysis of Alternatives, Site 3

This section summarizes how well each alternative satisfies each evaluation criterion and indicates how it compares to the other alternatives under consideration for Site 3.

#### 2.10.1.1 Overall Protection of Human Health and the Environment

For Site 3, the BERA concluded that the site did not pose a threat to ecological receptors. Thus, this criterion will be limited to whether each alternative provides adequate protection of human health only.

As no remedial action is undertaken with Alternative 1, it provides no protection of human health and the environment. Alternative 2 provides protection of human health by minimizing human receptor exposure to COCs in surface and subsurface soil by restricting access to the site and limit it to non-residential uses. This alternative would also implement institutional controls which would provide protection to any occupational and excavation/construction workers operating on the site. Alternative 3 provides protection of human health and the environment by completely removing the contaminated soil from the site. Alternative 4 provides protection of human health by minimizing human receptor exposure to COCs in surface and subsurface soil through the use of a physical barrier such as a soil cap. As contaminated soil will remain in place, LUCs must also be implemented, per Alternative 2.

#### 2.10.1.2 Compliance with ARARs and TBCs

ARAR compliance does not apply to Alternative 1. Each of the remaining three alternatives complies with identified ARARs and to be considered (TBC) criteria.

#### 2.10.1.3 Long-Term Effectiveness and Permanence

Alternative 1 provides no long-term effectiveness. For Alternative 2, successful implementation of this alternative requires proper documentation, communication of restrictions to Base personnel, compatibility with future land use and development plans, incorporation of restrictions with Base policy and permitting, regular inspections and continuous enforcement. Alternative 3 attains long-term effectiveness and permanence because source material is removed from the site and placed in a facility specially designed, constructed, and monitored to receive such wastes. No land use restrictions would be required upon the completion of the remedial action. Therefore, no long-term monitoring, LUCs, or 5-year reviews would be required. Alternative 4 attains long-term effectiveness and permanence because source material is placed underneath a soil cover, thereby reducing receptor exposure. However, long-term monitoring and maintenance will be required to ensure the integrity of the soil cover. In addition, as contaminated soil remains in place, LUCs will be required, as per Alternative 2.

#### 2.10.1.4 Reduction of Toxicity, Mobility, or Volume through Treatment

None of the four alternatives reduce the toxicity, mobility, or volume of contaminated media through treatment unless contaminated soil is stabilized prior to excavation and offsite disposal, a process that would result in reduced mobility.

#### 2.10.1.5 Short-Term Effectiveness

As no remedial actions are undertaken, Alternative 1 would not involve short-term physical disturbances of the site. For Alternative 2, with the use of access restrictions, no short-term risks to the community or to workers would occur as a result of implementing this alternative. Any additional engineering controls such as signage would be installed outside the area of contamination. Similarly, no environmental impact from construction activities would occur. For Alternative 3, there would be significant short-term physical disturbance of the site, and workers would be at risk of exposure to contaminants in soil during the soil removal and disposal operations. However, risks to workers could be mitigated during implementation of this alternative with the use of personal protective equipment, contaminant monitoring, and engineering controls to mitigate concerns about fugitive dust emissions and storm water management. Transport of hazardous materials or regulated substances is not considered particularly dangerous, especially in when considering the short distance (< 0.5 mile) from Site 3 to the Consolidation Unit. Similar to Alternative 3, Alternative 4 would involve a level of physical disturbance of the site, and workers would be at risk of exposure to contaminants in soil during the soil removal and disposal operations. However, the degree of disturbance would be considerably less than for Alternative 3, and workers would be protected during implementation of this alternative with personal protective equipment, contaminant monitoring, and engineering controls to mitigate concerns about fugitive dust emissions and storm water management.

#### 2.10.1.6 Implementability

This criterion is not applicable to Alternative 1, as no action would be taken. For Alternative 2, implementability is moderate, and requires annual inspections, monitoring and enforcement, training, and long-term communication (for purposes of evaluation, 30 years). Implementability for Alternative 3 is high, and uses conventional equipment for excavation, transport, and disposal. Since this action involves movement of soil, verification of response action objectives is straightforward. Excavated soil will be disposed of at the on-base consolidation unit, located adjacent (< 0.5 mile distant) to Site 3. Implementability for Alternative 4 is high, and like Alternative 3, uses conventional equipment for construction of the soil cap. In addition, annual inspections, reviews, and maintenance require a long-term commitment to manage the site. As contamination remains in place, LUCs would also be required.

#### 2.10.1.7 Cost

The present value cost of Alternative 1 is $0. The cost of Alternative 2 is calculated at $794,000, to be incurred over a 30-year period. The cost of Alternative 3 is calculated at $2,076,000, which would be incurred over a relatively short period of time (< 1 year). The cost of Alternative 4 is calculated to be $5,794,000. Capital costs associated with the construction of the soil cap ($2,827,000) would be realized over a relatively short period of time (approximately 1 year), with the remaining costs associated with monitoring, maintenance and LUCs incurred over a 30-year period. Detailed costs for the four alternatives are presented in Appendix C.

#### 2.10.1.8 Territorial Agency Acceptance

GEPA would not accept the no action alternative (Alternative 1) because it does not mitigate potential risks from impacted soil. Although the remaining alternatives do not involve destruction or reduction in toxicity, of contaminants, they do eliminate potential human health risks at the site. GEPA supported the use of any of the three remaining alternatives.

#### 2.10.1.9 Community Acceptance

At the time of the public review period, the Navy had selected Alternative 2: LUCs as the preferred alternative for Site 3. No written comments were received on the PP and no members of the public attended the public meeting. No objections to the preferred alternative for Site 3 were received from the public.

### 2.10.2 Comparative Analysis of Alternatives, Site 21

This section summarizes how well each alternative satisfies each evaluation criterion and indicates how it compares to the other alternatives under consideration for Site 21.

#### 2.10.2.1 Overall Protection of Human Health and the Environment

As no remedial action is undertaken with Alternative 1, it provides no protection of human health and the environment. Alternative 2 provides protection of human health and the environment by completely removing the contaminated soil from the site. Alternative 3 provides protection of human health by minimizing human receptor exposure to COCs in surface and subsurface soil through the use of a physical barrier such as a soil cap. As

contaminated soil will remain in place, LUCs must also be implemented that would restrict access to the site and limit it to non-residential uses.

#### 2.10.2.2 Compliance with ARARs and TBCs

Alternative 1 does not comply with the identified ARARs and TBC criteria. Each of the remaining two alternatives complies with identified ARARs and TBC criteria.

#### 2.10.2.3 Long-Term Effectiveness and Permanence

Alternative 1 provides no long-term effectiveness. Alternative 2 attains long-term effectiveness and permanence because source material is removed from the site and placed in a facility specially designed, constructed, and monitored to receive such wastes. No land use restrictions would be required upon the completion of the remedial action. Therefore, no long-term monitoring, LUCs, or 5-year reviews would be required. Alternative 3 attains long-term effectiveness and permanence because source material is placed underneath a soil cover, thereby reducing receptor exposure. However, long-term monitoring and maintenance will be required to ensure the integrity of the soil cover. In addition, as contaminated soil remains in place, LUCs will be required, involving proper documentation, communication of restrictions to Base personnel, compatibility with future land use and development plans, incorporation of restrictions with Base policy and permitting, regular inspections and continuous enforcement.

#### 2.10.2.4 Reduction of Toxicity, Mobility, or Volume through Treatment

None of the three alternatives reduce the toxicity, mobility, or volume of contaminated media through treatment unless contaminated soil is stabilized prior to excavation and offsite disposal, a process that would result in reduced mobility.

#### 2.10.2.5 Short-Term Effectiveness

As no remedial actions are undertaken, Alternative 1 would not involve short-term physical disturbances of the site. For Alternative 2, there would be significant short-term physical disturbance of the site. However, workers would be protected during implementation of this alternative with the use of personal protective equipment, contaminant monitoring, and engineering controls to mitigate concerns about fugitive dust emissions and storm water management. Transport of hazardous materials or regulated substances is not considered dangerous. Similar to Alternative 2, Alternative 3 would involve a level of physical disturbance of the site. However, workers would be protected during implementation of this alternative with personal protective equipment, contaminant monitoring, and engineering controls to mitigate concerns about fugitive dust emissions and storm water management.

#### 2.10.2.6 Implementability

This criterion is not applicable to Alternative 1, as no action would be taken. Implementability for Alternative 2 is high, and uses conventional equipment for excavation, transport, and disposal. Since this action involves movement of soil, verification of response action objectives is straightforward. Excavated soil will be disposed of at the on-base Consolidation Unit, located approximate 4.3 miles away. Implementability for Alternative 3 is high, and like Alternative 2, uses conventional equipment for construction of the soil cap.

In addition, annual inspections, reviews, and maintenance require a long-term commitment to manage the site. As contamination remains in place, LUCs would also be required involving annual inspections, monitoring and enforcement, training, and communication over a lengthy period of time (for purposes of evaluation, 30 years).

#### 2.10.2.7 Cost

The present value cost of Alternative 1 is $0. The cost of Alternative 2 is calculated at $468,000, which would be incurred over a relatively short period of time (< 6 months). The cost of Alternative 3 is calculated to be $1,404,000. Capital costs associated with the construction of the soil cap ($517,000) would be realized over a relatively short period of time (< 1 year), with the remaining costs associated with monitoring, maintenance and LUCs incurred over a 30-year period. Detailed costs for the four alternatives are presented in Appendix C.

#### 2.10.2.8 Territorial Agency Acceptance

GEPA would not accept the no action alternative (Alternative 1) because it does not mitigate potential risks from impacted soil. Although the remaining alternatives do not involve contaminant destruction or reduction in toxicity of contaminants, they do eliminate potential human health risks at the site. GEPA supported the use of any of the remaining alternatives.

#### 2.10.2.9 Community Acceptance

At the time of the public review period, the Navy had selected Alternative 2: Soil removal and offsite disposal as the preferred alternative for Site 21. No written comments were received on the PP and no members of the public attended the public meeting. No objections to the preferred alternative for Site 3 were received from the public.

## 2.11 Principal Threat Wastes

The NCP expects that treatment that reduces the toxicity, mobility, or volume of the principal threat wastes will be used to the extent practicable. The principal threat concept refers to the source materials at a CERCLA site considered to be highly toxic or highly mobile that generally cannot be reliably controlled in place or present a significant risk to human health or the environment should exposure occur. A source material is material that contains hazardous substances, pollutants, or contaminants that act as a reservoir for migration of contamination to groundwater or air, or that acts as a source for direct exposure. No principal threat wastes are present at Site 3 or at Site 21.

## 2.12 Selected Remedies

The primary indicator of remedial action performance will be satisfying the RAOs for Site 3 and Site 21 which are protecting human health and the environment. Performance measures are defined herein as the RAOs (see Section 2.8 – Remedial Action Objectives) plus the required actions to achieve the objectives, as defined in this section. It is anticipated that successful implementation, operation, maintenance, and completion of the performance measures will achieve a protective and legally compliant remedy for Site 3 and Site 21. Remedy selections are based on the detailed evaluation of remedial alternatives presented in the 2010 FS (AECOM 2010a).

The Navy is responsible for implementing, maintaining, and monitoring the remedial actions identified herein for the duration of the remedies selected in this ROD. The Navy will exercise this responsibility in accordance with CERCLA and the NCP. Approval by the EPA and GEPA is required for any modification of the remedy inconsistent with the objectives of this ROD. This section describes the selected remedy and also provides specific performance measures for the selected remedy.

### 2.12.1 Preferred Remedial Alternative, Site 3

Alternative 2, LUCs, was selected as the preferred remedy for Site 3 based upon its implementability, suitability with the existing site conditions (e.g., the disseminated nature of contamination at Site 3) and site location, and its ability to accomplish RAOs in a cost-effective manner. It is expected that this remedy will remain in effect and be protective of human health and the environment in the long term. LUCs will remain in effect for as long as site conditions pose an unacceptable risk to occupational workers and potential future residents.

#### 2.12.1.1 Summary of the Rationale for the Selected Remedy, Site 3

The selected remedial alternative for Site 3 is Alternative 2 – LUCs. The Navy, EPA, and GEPA believe that the selected remedy meets the threshold criteria and provides the best balance of tradeoffs among the other alternatives with respect to the balancing and modifying criteria. The remedy is expected to satisfy the nine criteria of CERCLA § 121(b):

- Threshold criteria
- Protection of human health and the environment
- Compliance with ARARs
- Balancing criteria
- Long-term effectiveness and permanence
- Toxicity, mobility, or volume reduction through treatment
- Short-term effectiveness
- Implementability
- Cost
- Modifying criteria
- Territorial agency acceptance
- Community acceptance

Both Alternative 2 (LUCs) and Alternative 3 (Soil Removal) are protective of human health, effective in both the short-term and long-term, comply with ARARs, and are readily implementable. While Alternative 3 may arguably offer an additional level of protection by removing all contaminated media from the site with placement in a facility designed to contain such waste, the extent of the remedial action necessary to address isolated pockets of contamination within the abandoned quarry to an unrestricted land use is cost prohibitive

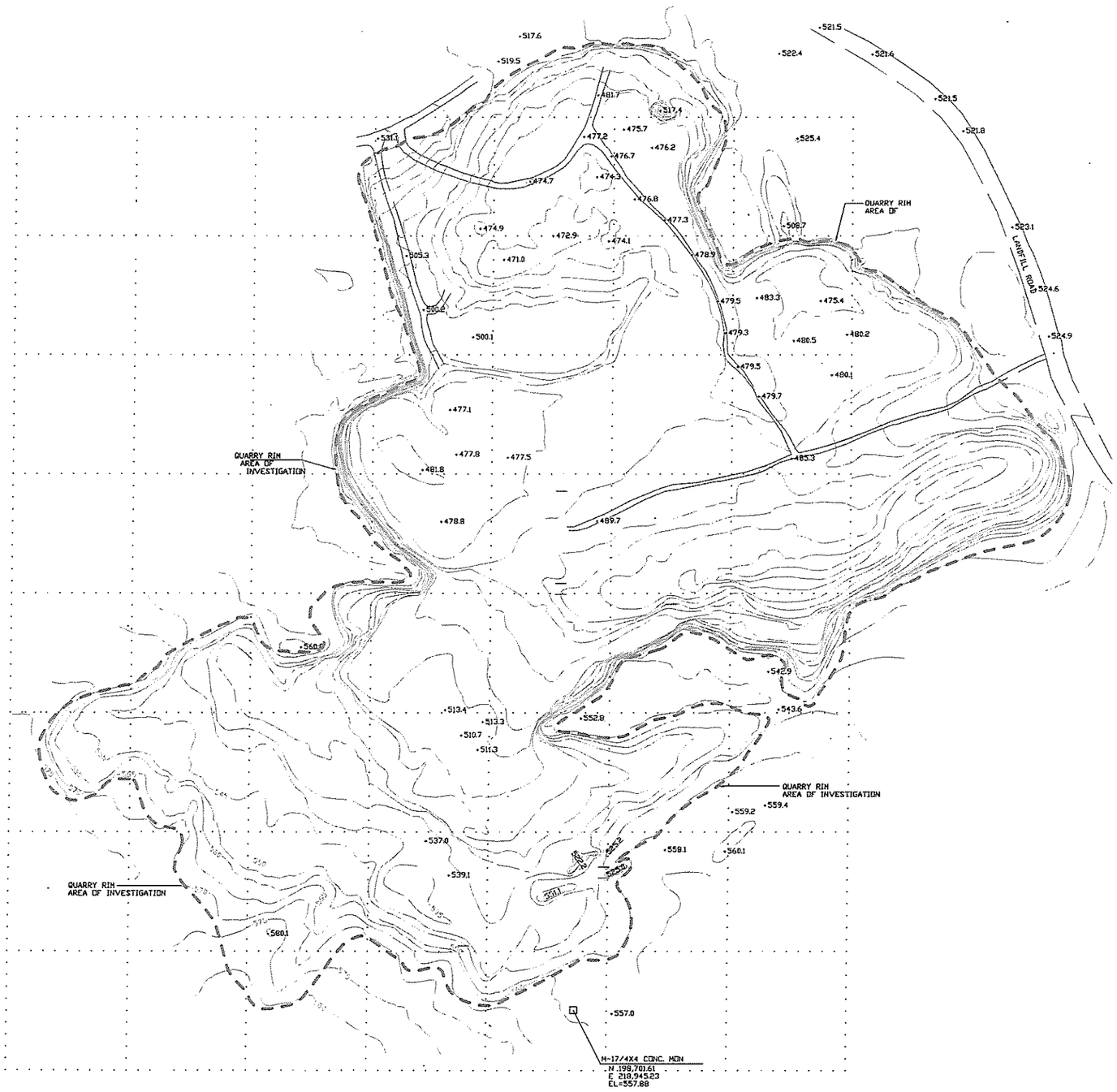
and impractical. Additionally, Site 3 is located within the landfill complex, and within close proximity of the flight line (< 0.5 mile), conditions that restrict access and already limit it to industrial use. Under these circumstances, the exposure scenario with the receptors shown to be at greatest risk based upon the results of the HHRA–adult and child residents–would not be permitted. Therefore, Alternative 2 (LUCs) has been selected as the remedy for Site 3.

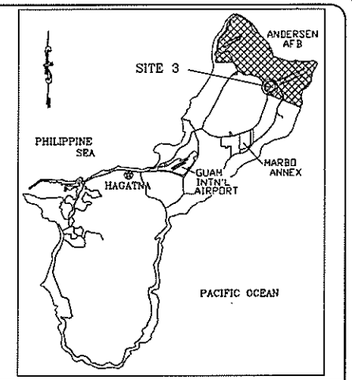
#### 2.12.1.2 Description of the Selected Remedy

The LUC boundary for Site 3 is shown on Figure 10. The LUCs have been selected to protect occupational workers and possible future residents from potential exposure to surface and shallow subsurface soils containing COCs at concentrations that would pose an excess cancer risk (i.e., greater than the risk range of 1E–04 to 1E–06), excess non-cancer risk (i.e., HI greater than 1), or risks associated with lead through dermal contact, incidental ingestion, and/or inhalation of particulates. Surface and shallow subsurface soils at Site 3 contain the metals antimony, arsenic, cobalt, and lead; PCBs; PAHs; and the pesticide dieldrin at concentrations that exceed screening levels (i.e., EPA RSLs). The risks to human health and ecological receptors are summarized in Section 2.7.

At Site 3, current (and foreseeable) land use is zoned for industrial usage within the landfill complex. Additionally, the site is adjacent to an active consolidation unit for waste disposal – an end use that may be applicable for Site 3 considering planned military base reassignments. Institutional (legal) controls and engineered controls at Site 3 will adequately protect human and ecological receptors from the risks posed by remaining contamination at the site.

Specific RGs that will be met through LUCs for Site 3 are to prevent exposure to contaminated surface and shallow subsurface soils containing these COCs, thereby reducing or eliminating contaminant exposure to human receptors through dermal contact, ingestion, and inhalation of particulates. LUCs will include institutional (legal) controls and engineering controls.




## LEGEND

- 4" X 4" CONCRETE MONUMENT
- 5-FOOT TOPOGRAPHIC CONTOUR
- CORAL ROAD
- 480.2 SPOT ELEVATION
- LAND USE CONTROL BOUNDARY

AAFB01S03S037 (SAMPLE ID)
5.00-6.00 (SAMPLE DEPTH IN FEET)

| | |
|---|---|
| As | Arsenic |
| B(a)A | Benzo(a)anthracene |
| B(a)P | Benzo(a)pyrene |
| B(b)F | Benzo(b)fluoranthene |
| B(k)F | Benzo(k)fluoranthene |
| Co | Cobalt |
| DiB | Dibenz(a,h)anthracene |
| Fe | Iron |
| Hg | Mercury |
| Ind | Indero(1,2,3-cd)pyrene |
| Pb | Lead |
| Sb | Antimony |

## NOTES

| | |
|---|---|
| Organic analytes | Reported in µg/kg |
| Inorganic analytes | Reported in mg/kg |
| Non- BOLD | Concentration exceeds residential RSL |
| BOLD | Concentration exceeds industrial RSL |

**Only analytes with results above screening values are shown.**

N

200 0 200

GRAPHIC SCALE IN FEET

*(modified from ICF, 1998)*

**Figure 10**
**Proposed Land Use Control Boundary, IRP Site 03**
**Record of Decision for IRP Sites 3 and 21**
**Andersen AFB, Guam**

L:\work\AFCEE\Guam\TO 0025 (60133951)\Reports\RI Report\Andersen Figures\IRP Sites 3&21\Fig10_Proposed_LUC_IRP Site03.ai 4/16/2010 rks

The following is a list of specific objectives for LUCs at Site 3:

1. Prevent unauthorized access.
2. Prohibit the development and use of property for residential housing, elementary and secondary schools, child care facilities and playgrounds.
3. Control human exposure to subsurface soils.

LUCs required for this site will include notice of the contamination in the Navy record systems and the Base General Plan, and restrictions on land use to accomplish the above list of specific objectives, including a requirement for prior written approval of all future construction or demolition activities within the area(s) of remaining contamination. These LUCs will run in perpetuity, or until they are no longer necessary for the protection of human health and the environment. Annual monitoring will be required to ensure that site uses have not changed through physical inspections of the site, paying special attention to any site construction, signs of vegetation loss, and other site disturbances. A records search shall also be conducted to ensure that proper notice of site contamination is readily available.

The Navy is responsible for implementing, maintaining, reporting on, and enforcing the LUCs. This may be modified to include another party should the site-specific circumstances warrant it.

A LUC remedial design will be prepared as the land use component of the remedial design. Within 90 days of ROD signature, the Navy shall prepare and submit to EPA for review and approval a LUC remedial design that shall contain implementation and maintenance actions, including periodic inspections.

Any activity that is inconsistent with the institutional control objectives or use restrictions, or any other action that may interfere with the effectiveness of the institutional controls will be addressed by the Navy as soon as practicable, but in no case will the process be initiated later than 10 days after the Navy becomes aware of the breach.

The Navy will notify EPA and GEPA as soon as practicable but no longer than 10 days after discovery of any activity that is inconsistent with the institutional control objectives or use restrictions, or any other action that may interfere with the effectiveness of the institutional controls. The Navy will notify EPA and GEPA regarding how the Navy has addressed or will address the breach within 10 days of sending EPA and GEPA notification of the breach.

The Navy shall notify EPA and GEPA 45 days in advance of any proposed land use changes that are inconsistent with LUC objectives or the selected remedy.

The Navy will provide notice to EPA and GEPA at least 6 months prior to any transfer or sale of Site 3 so that EPA and GEPA can be involved in discussions to ensure that appropriate provisions are included in the transfer terms or conveyance documents to maintain effective institutional controls. If it is not possible for the facility to notify EPA and GEPA at least 6 months prior to any transfer or sale, then the facility will notify EPA and GEPA as soon as possible but no later than 60 days prior to the transfer or sale of any

property subject to institutional controls. In addition to the land transfer notice and discussion provisions above, the Navy further agrees to provide EPA and GEPA with similar notice, within the same time frames, as to Federal-to-Federal transfer of the property. The Navy shall provide a copy of executed deed or transfer assembly to EPA and GEPA.

The Navy shall not modify or terminate LUCs, implementation actions, or modify land use without approval by EPA and GEPA. The Navy shall seek prior concurrence before any anticipated action that may disrupt the effectiveness of the LUCs or any action that may alter or negate the need for LUCs.

Monitoring of the environmental use restrictions and controls will be conducted annually by the Navy. The monitoring results will be included in a separate report or as a section of another environmental report, if appropriate, and provided to the EPA and GEPA. The annual monitoring reports will be used in preparation of the Five Year Review to evaluate the effectiveness of the remedy. Formal 5-year reviews are required by CERCLA for remedial actions that leave COCs in place at concentrations that do not allow for unlimited land use and unrestricted exposure. Under the selected remedy, COCs may remain in place at such concentrations at Site 3, and CERCLA 5-year reviews will be required as part of the selected remedy. The 5-year reviews will be necessary as long as COCs remain at levels above those suitable for unrestricted reuse.

The annual monitoring report, submitted to the regulatory agencies by the Navy, will evaluate the status of the institutional controls and how any institutional control deficiencies or inconsistent uses have been addressed. The annual evaluation will address whether the use restrictions and controls references above were communicated in the deed(s), whether the owners and State and Local agencies were notified of the use restrictions and controls affecting the property, and whether use of the property has conformed with such restrictions and controls.

The following is a list of specific LUC requirements for Site 3:

- Land use (i.e., current and foreseeable) is used for industrial purposes within the area of the landfill.
- LUCs will include a notice of contamination in the Real Property records system and the Base General Plan and a restriction on residential development.
- LUCs will be maintained until the concentration of contaminants of concern (COCs) in the soil are at such levels to allow for unrestricted use and exposure.
- Annual monitoring through physical inspections will be conducted to ensure that LUCs are enforced and posted warning signs are visible. The annual inspection forms will be maintained in the Land Use Control Management Plan (LUCMP).
- Restrictions on land use will be noted at the Real Property office, incorporated in the Base General Plan, and entered on the Andersen AFB geographic information system (GIS) environmental layer overlay indicating the types of LUCs implemented for the site.

- No intrusive activities shall occur within a designated LUC area without prior written approval of the Navy in the form of a dig and/or construction permit. If intrusive activities are conducted within the designated LUC area, the work would require an approved health and safety work plan and procedures for the proper handling and disposal of displaced waste and/or soil. Dig and construction permits shall be maintained as part of the LUCMP.
- The Navy will conduct formal 5-year reviews at Site 3, as required by CERCLA, because contamination is left in place. The 5-year reviews will continue as long as COCs remain at levels above those suitable for unrestricted use of the site.

**Deed Restrictions**

Each transfer of fee title from the U.S. will include a CERCLA 120(h)(3) covenant which will have a description of the residual contamination on the property and the environmental use restrictions, expressly prohibiting activities inconsistent with the performance measure goals and objectives.

The environmental restrictions are included in a section of the CERCLA 120(h)(3) covenant that the U.S. is required to include in the deed for any property that has had hazardous substances stored for one year or more, known to have been released or disposed of on the property. Each deed will also contain a reservation of access to the property for the Navy, EPA, and the State of Hawaii, and their respective officials, agents, employees, contractors, and subcontractors for purposes consistent with the Navy IRP or the FFA. The deed will contain appropriate provisions to ensure that the restrictions continue to run with the land and are enforceable by the Navy.

**Lease Restrictions**

During the time between the adoption of this ROD and deeding of the property, equivalent restrictions are being implemented by lease terms, which are no less restrictive than the use restrictions and controls described above, in this ROD. These lease terms shall remain in place until the property is transferred by deed, at which time they will be superceded by the institutional controls described in this ROD.

**Notice**

Concurrent with the transfer of fee title from the Navy to transferee, information regarding the environmental use restrictions and controls will be communicated in writing to the property owners and to appropriate State and Local agencies to ensure such agencies can factor such conditions into their oversight and decision-making activities regarding the property.

It is important to note that the remedy may change somewhat as a result of the remedial design and construction processes. Changes, if they occur, to the remedy as described in this ROD will be documented using a technical memorandum in the AR, an Explanation of Significant Differences (ESD), or ROD amendment.

### 2.12.1.3 Summary of Estimated Remedy Costs

The cost estimate for Alternative 2 is presented in Table 2-20. The information provided in this cost estimate summary table is based on the best available information regarding the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. Major changes may be documented in the form of a memorandum in the AR file, an ESD, or a ROD amendment. This is an order-of-magnitude engineering cost estimate that is expected to be within +50% to -30% of the actual project cost.

**Table 2-20: Preferred Remedial Alternative Cost Estimate Summary, Site 3**

| | Site 03 | | | |
|---|---|---|---|---|
| **Component Description** | **QTY** | **Unit** | **Unit Price** | **Component Cost** |
| **Capital Costs** | | | | |
| **1. Well Abandonment (from Alternative 1)** | | | | **$0** |
| **2. LUCs** | | | | |
| Incorporate Restrictions into General Plan | 1 | LS | $10,000 | $10,000 |
| Delineate Area onto Master Planning Maps | 1 | LS | $10,000 | $10,000 |
| Update GIS Database with LUCs | 1 | LS | $10,000 | $10,000 |
| Communicate LUCs | 1 | LS | $10,000 | $10,000 |
| ***Subtotal*** | | | | *$40,000* |
| Contingency and Project Management & Administrative Costs | 30% | | | $12,000 |
| ***Subtotal*** | | | | *$52,000* |
| ***Subtotal (including 4.00% Guam GET)*** | | | | *$54,080* |
| **Capital Costs of LUCs** | | | | **$54,080** |
| TOTAL CAPITAL COSTS | | | | **$54,080** |
| **O&M Costs** | | | | |
| **1. LUC Annual Training and Inspections (year 1 through year 30)** | | | | |
| Annual Training | 8 | HR | $100 | $800 |
| Annual Inspection and Reporting | 1 | LS | $14,000 | $14,000 |
| ***Subtotal*** | | | | *$14,800* |
| Contingency and Project Management & Administrative Costs | 30% | | | $4,440 |
| ***Subtotal*** | | | | *$19,240* |
| ***Subtotal (including 4.00% Guam GET)*** | | | *Annual Total Program total (with 3% Discount)* | *$20,010* **$582,279** |
| **LUC O&M Program Costs (30 years)** | | | | **$582,279** |

| Component Description | Site 03 QTY | Unit | Unit Price | Component Cost |
|---|---|---|---|---|
| **Periodic Costs** | | | | |
| **1. Five-Year Reviews** | | | | |
| Five-Year Reviews (years 5, 10, 15, 20, 25, 30) | 1 | LS | $20,000 | $20,000 |
| ***Subtotal*** | | | | *$20,000* |
| Contingency and Project Management & Administrative Costs | 30% | | | $6,000 |
| ***Subtotal*** | | | | *$26,000* |
| ***Subtotal (including 4.00% Guam GET)*** | | | *Event Total Program total (with 3% Discount)* | *$27,040* **$157,373** |
| **PERIODIC PROGRAM COSTS** | | | | **$157,373** |
| **Total Present Worth Project Costs** | | | | **$793,732** |

Primary Assumptions: (1) Costs are in 2009 U.S. dollars, and (2) Duration is 30 years.
GET general excise tax
HR hour
LS lump sum
QTY quantity

## 2.12.2 Preferred Remedial Alternative, Site 21

Alternative 2, Soil Removal, was selected as the preferred remedy for Site 21 due to its ability to protect ecological receptors, its effectiveness, permanence, suitability, and cost effectiveness in attaining RAOs. As Alternative 2 involves the removal of contaminated media from the site, it is protective of both human health and the environment in the long term. No land use restrictions would be required upon the completion of the remedial action. Therefore, no long-term monitoring, LUCs, or 5-year reviews would be required.

### 2.12.2.1 Summary of the Rationale for the Selected Remedy

The selected remedial alternative for Site 21 is Alternative 2—Soil Removal. The Navy, EPA, and GEPA believe that the selected remedy meets the threshold criteria and provides the best balance of tradeoffs among the other alternatives with respect to the balancing and modifying criteria. The remedy is expected to satisfy the nine criteria of CERCLA § 121(b):

- Threshold criteria
- Protection of human health and the environment
- Compliance with ARARs
- Balancing criteria
- Long-term effectiveness and permanence
- Toxicity, mobility or volume reduction through treatment
- Short-term effectiveness
- Implementability

- Cost
- Modifying criteria
- Territorial agency acceptance
- Community acceptance

While Alternatives 2, 3, and 4 offer a level of protection of human health, only Alternative 2 would be protective of ecological receptors as well, as contaminated media would be removed from the site and transported to a facility designed to contain such wastes. Further, contamination at Site 21 is limited to shallow soils in two relatively isolated areas (i.e., the elongated trench and the drum accumulation area), a situation that is conducive to source removal, and one that would accomplish RAOs and return the site to unrestricted use in a short (< 1 year) timeframe without the need for additional monitoring, or maintenance. No LUCs would be required. Alternative 2, while representing the most protective of the evaluated alternatives, is also the most cost-effective both in the short-term and long-term. Additionally, Alternative 2 is preferred by both the Territorial government and the public.

#### 2.12.2.2 Description of the Selected Remedy

For Site 21, Alternative 2 (Soil Removal) is the selected remedy. Contamination at the site is limited to shallow soils in two relatively isolated areas, the elongated trench in the southwest corner of the site, and the drum accumulation area near the northern site boundary. These areas are illustrated on Figure 11. The estimated volume of media to be removed is readily delineated and consists of approximately 3,700 cubic yards. Solid waste debris (asphalt, metal, concrete) would need to be removed from the soil prior to treatment. Solid waste debris would subsequently need to be properly disposed of. Screening, management, and disposal of MEC would be necessary.

Excavated areas will be backfilled with clean, on-island soil and re-vegetated. Excavated contaminated media will be disposed of at the Andersen AFB Consolidation Unit located at IRP Site 2, located 4.3 miles from Site 21. The Consolidation Unit is permitted to accept CERCLA waste. LUCs (i.e., engineering and institutional controls), long-term monitoring, and compliance reporting will not be required.

It should be noted that as part of any proposed removal action, ecological surveys and monitoring would need to be conducted to minimize disturbance or disruption of any endangered or threatened flora or fauna.

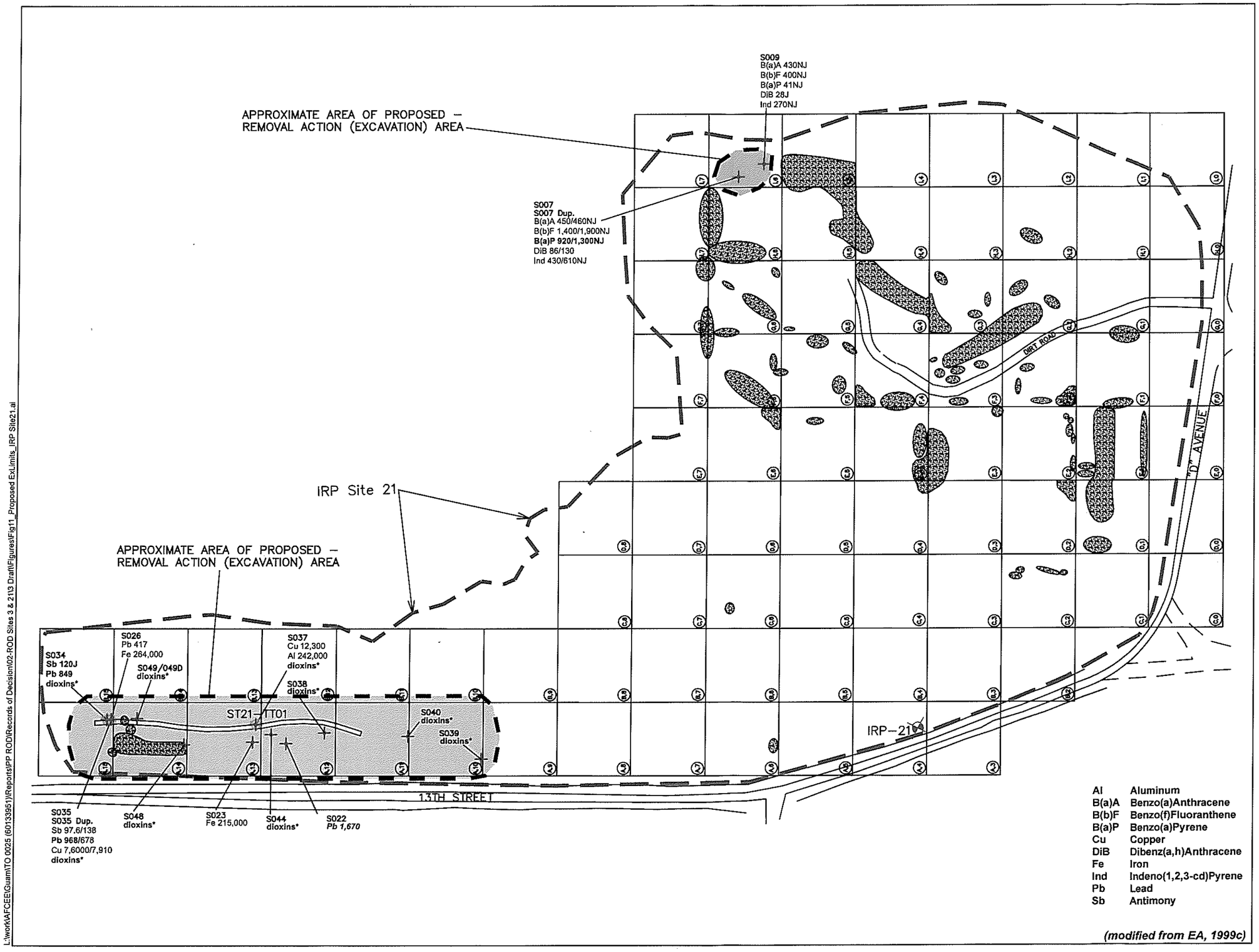
#### 2.12.2.3 Summary of Estimated Remedy Costs

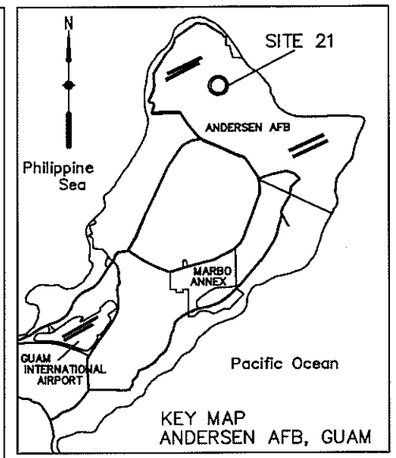
The cost estimate for Alternative 2 is presented in Table 2-21. Note that the information in this cost estimate summary table is based on the best available information regarding the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. Significant changes may be documented in the form of a memorandum in the AR file, an ESD, or a ROD amendment. This is an order of magnitude engineering cost estimate that is expected to be within +50% to -30% of the actual project cost.

**Table 2-21: Preferred Remedial Alternative Cost Estimate Summary, Site 21**

| Component Description | Site 21 | | | |
|---|---|---|---|---|
| | QTY | Unit | Unit Price | Component Cost |
| **Capital Costs** | | | | |
| **1. Well Abandonment (from Alternative 1)** | | | | **$0** |
| **2. Source Removal - Excavate and Remove** | | | | |
| Mobilize and Site Preparation | 1 | LS | $10,946 | $10,946 |
| Clear & Grub | 1 | LS | $8,954 | $8,954 |
| MEC Oversight | 1 | LS | $187,091 | $187,091 |
| Excavate & Backfill | 3,700 | CY | $19 | $70,300 |
| Confirmation/Verification Sampling & Analysis | 1 | LS | $69,160 | $69,160 |
| Miscellaneous Allowance | 10% | | | $34,645 |
| ***Subtotal*** | | | | *$381,096* |
| Contingency | 10% | | | $34,645 |
| ***Subtotal*** | | | | *$415,741* |
| Project Management & Administrative Costs | 10% | | | $34,645 |
| ***Subtotal*** | | | | *$450,387* |
| ***Subtotal (including 4.00% Guam GET)*** | | | | *$468,402* |
| **Capital Costs of Source Removal** | | | | **$468,402** |
| **TOTAL CAPITAL COSTS** | | | | **$468,402** |
| **O&M Costs** | | | | **$0** |
| **Periodic Costs** | | | | **$0** |
| **Total Present Worth Project Costs (per site)** | | | | **$468,402** |

Notes:
Primary Assumptions
1) Costs are in 2009 U.S. dollars.
2) There would be no disposal cost or waste acceptance fee since wastes would be disposed of at an onsite consolidation unit.
Site-Specific Assumptions
1) Costs include MEC oversight and removal during field activities.
2) A hydraulic backhoe will be used for excavation.




**LEGEND**

- SURFACE SOIL SAMPLE LOCATION WITH EXCEEDANCE
- SUBSURFACE SOIL SAMPLE LOCATION
- OPEN TRENCH
- METAL DEBRIS
- IRP–21 MONITORING WELL
- APPROXIMATE SITE BOUNDARY
- GRID BLOCK IDENTIFICATION

**NOTES**

NOTE: ONLY ANALYTES WITH RESULTS ABOVE SCREENING VALUES ARE SHOWN.

INORGANIC CONCENTRATIONS IN mg/kg

ORGANIC CONCENTRATIONS IN µg/kg

| | |
|---|---|
| Non-Bold | CONCENTRATION EXCEEDS RESIDENTIAL RSL |
| **Bold** | CONCENTRATION EXCEEDS INDUSTRIAL RSL |
| dioxins* | REFER TO TEXT |

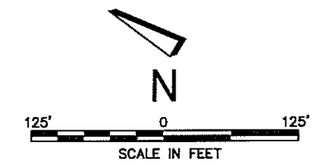



**Figure 11**
**Proposed Excavation Areas, IRP Site 21**
**Record of Decision, IRP Sites 3 and 21**
**Andersen AFB, Guam**

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## 2.13 Statutory Determinations

Under CERCLA § 121 (as required by NCP § 300.430(f)(5)(ii)), the lead agency must select a remedy that is protective of human health and the environment, complies with ARARs, is cost-effective, and uses permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable.

### 2.13.1 Statutory Determinations, Site 3

#### 2.13.1.1 Protection of Human Health and the Environment

Alternative 2 provides protection of human health by minimizing human receptor exposure to COCs in surface and subsurface soil through restricting access to the site. LUCs would include notice of the contamination in the Navy record systems and restrictions on land use, including prior written approval for all future construction or demolition activities within the area(s) of remaining contamination. These LUCs will be maintained until the concentration of COCs in the soil and groundwater are at such levels to allow for unrestricted use and exposure. Annual monitoring and enforcement will be required to ensure that site uses have not changed through physical inspections of the site, paying special attention to any site construction, signs of vegetation loss, and other site disturbances. A records search should also be made to ensure that proper notice of site contamination is readily available.

Formal 5-year reviews are required by CERCLA for remedial actions that leave COCs in place at concentrations that do not allow for unlimited land use and unrestricted exposure.

Under the recommended alternative, COCs may remain in place at such concentrations at Site 3, and CERCLA 5-year reviews will be required as part of the recommended alternative. The 5-year reviews will be necessary as long as COCs remain at levels above those suitable for unrestricted reuse (for costing purposes, estimated at 30 years).

#### 2.13.1.2 Compliance with ARARs

Remedial actions must comply with both Federal and State ARARs. ARARs are legally applicable or relevant and appropriate Federal and State requirements, standards, criteria, and limitations.

ARARs fall into three categories: contaminant-specific, location-specific, and action-specific. Contaminant-specific ARARs are health-based or risk-management-based numbers that provide concentration limits for the occurrence of a contaminant in the environment. Location-specific ARARs restrict activities in certain sensitive environments. Action-specific ARARs are activity-based or technology-based, and typically control remedial activities that generate hazardous wastes (such as with those covered under the RCRA). Offsite shipment, treatment, and disposal of excavated contaminated soil invoke action-specific ARARs. Criteria TBC are non-promulgated advisories or guidance issued by Federal or State governments that are not legally binding and do not have the status of potential ARARs. However, in many circumstances, TBCs are considered along with ARARs. If a TBC is actually selected in the ROD, it must be complied with.

Table 2-22 summarizes the ARARs and TBCs for the selected remedy at Site 3 and describes how the selected remedy addresses each one.

The selected remedy complies with the contaminant-specific, location-specific, and action-specific ARARs. The implementation of the remedy is required to meet the substantive portions of these requirements and is exempt from administrative requirements such as permitting and notifications.

#### 2.13.1.3 Cost Effectiveness

LUCs provide the greatest potential return on investment when compared to the other alternatives. The LUC alternative is also effective because the costs associated with this alternative are proportional to its overall effectiveness. In making this determination, the following definition was used: "A remedy shall be cost-effective if its costs are proportional to its overall effectiveness" (40 Code of Federal Regulations [CFR] 300.430(f)(1)(ii)(D)). This determination was accomplished by evaluating the "overall effectiveness" of those alternatives that satisfy the threshold criteria (that is, are protective of human health and the environment and ARAR-compliant).

Overall effectiveness was evaluated by assessing three of the five balancing criteria in combination: long-term effectiveness and permanence; reduction in toxicity, mobility, and volume through treatment; and short-term effectiveness. Overall effectiveness was then compared to costs to determine cost-effectiveness. The overall effectiveness of the selected remedy for Site 3 was demonstrated in the comparative analysis of alternatives (Section 2.10 – Summary of Comparative Analysis of Alternatives) and is summarized in Table 2-23. The estimated present worth cost of the selected remedy (in 2009 dollars) is $794,000.

**Table 2-22: Description of ARARs and TBCs, Site 3**

| Type | Authority | Medium | Requirement | Status | Synopsis of Requirement | Action to be Taken to Attain Requirement |
|---|---|---|---|---|---|---|
| Contaminant-Specific | Federal Regulatory Requirement | Soil, Air and Groundwater | EPA Residential RSLs (EPA 2009) | TBC for COCs | RSLs combine current EPA toxicity values and standard exposure factors to estimate contaminant concentrations in environmental media that are protective of humans, including sensitive groups, over a lifetime. RSLs are generic criteria that can be used at all sites but do not consider natural background levels, ecological receptors, protection of groundwater, or all potential exposure pathways. The exposure pathways addressed in the development of RSLs include ingestion and inhalation of particulates, inhalation of volatiles, and dermal absorption. | The selected remedy will comply with this requirement through LUCs that will prevent use of the Site for residential purposes. |
| Action-Specific | Federal Regulatory Requirement | Soil | Department of Defense and Air Force Policy and Guidance on LUCs Associated with Environmental Restoration Activities for Active Installations (DoD 2001, AF 2003) | TBC for LUCs | Provides guidance on selecting, layering, implementing, documenting, and managing LUCs at active military installations. | The selected remedy for Site 3, providing for LUCs, should be designed and documented in accordance with the policy and guidance. |
| Action-Specific | Federal Regulatory Requirement | Waste Stream | 40 CFR 262.11-Hazardous Waste Determination | Applicable Requirement | This regulation requires generators of solid waste to determine whether their waste is regulated as hazardous waste, according to 40 CFR 261. | Waste streams generated during the remedial action will be tested to determine whether they are RCRA hazardous and will be stored, transported, and disposed of accordingly.<br>Based on site investigation results, it is not anticipated that generated wastes will be found to be RCRA hazardous. |

| Type | Authority | Medium | Requirement | Status | Synopsis of Requirement | Action to be Taken to Attain Requirement |
|---|---|---|---|---|---|---|
| Action-Specific | Territorial Regulatory Requirement | Air | Guam Air Pollution Control Standards and Regulations, Section 1103.4 - Fugitive Dust | Applicable Requirement | This regulation prohibits visible fugitive dust from becoming airborne without taking reasonable precautions. | Onsite excavation and material handling can use precautions, such as water or contaminant suppression, covering trucks and roadway cleaning and maintenance to reduce fugitive dust emissions. |
| Action-Specific | Federal Regulatory Requirement | Air | 40 CFR 50.6 and 50.12 – Ambient Air Quality Standards Construction and excavation actions must comply with ambient air quality standards during excavation activities | Applicable Requirement | Construction and excavation actions must comply with ambient air quality standards during excavation activities. | Dust emissions created from excavation activities must be monitored. Air pollution controls, such as dust suppression techniques, may be necessary to maintain air quality and keep particulate emissions to a minimum. Note that Guam air quality standards (GAPCSR, Section 1103.2 – Ambient Air Quality Standards) are not more stringent than the Federal air quality standards and therefore are not ARARs. |
| Location-Specific | Federal Regulatory Requirement | Soil | Archaeological Resources Protection Act of 1979 (16 U.S.C. 470ii) | Applicable Requirement | The Archaeological Resources Protection Act of 1979 is a Federal program mandating protection of any archaeological resources if discovered. | In the event that historic or prehistoric artifacts are uncovered during remedial activities, mitigation measures to protect the area would be required. Andersen AFB has developed an Archaeological Monitoring Plan for environmental projects and would be implemented as appropriate. |

| Type | Authority | Medium | Requirement | Status | Synopsis of Requirement | Action to be Taken to Attain Requirement |
|---|---|---|---|---|---|---|
| Location-Specific | Territorial Regulatory Requirement | Soil | Guam Historic Preservation Regulations (21 Guam Code Annotated Chapter 76) | Applicable Requirement | Governs the identification, preservation, and protection of significant cultural resources in Guam. Establishes the State Register of Historic Places and assigns authority for implementing the National Historic Preservation Act to the State Historic Preservation Officer. | The State Historic Preservation Officer is responsible for managing significant national and State historic and archaeological resources within the territory of Guam. In the event that significant historic and archaeological resources within the meaning of these regulations are uncovered during remedial activities, mitigation measures to protect the area would be required, as discussed above with respect to 16 U.S.C. 470. |
| Location-Specific | Federal Regulatory Requirement | Biota | Endangered Species Act (16 U.S.C 1531 and 50 CFR 200, 402) and Fish and Wildlife Coordination Act (16 U.S.C 661 and CFR 320 to 330) | Applicable Requirement | The ESA is administered by two Federal agencies, the National Oceanic and Atmospheric Administration (marine species), and the USFWS (freshwater fish and all other species). This act protects species and also "the ecosystems upon which they depend." | The selected remedy will comply with this requirement by ensuring that no adverse impact to any endangered species or its habitat occurs. |

**Table 2-23: Cost and Effectiveness Summary for Site 3**

| Alternative | Present-Worth Cost | Incremental Cost (if applicable) | Long-Term Effectiveness and Permanence | Reduction of Toxicity, Mobility or Volume Through Treatment | Short-Term Effectiveness |
|---|---|---|---|---|---|
| 1 – No Action | $0 | $0 | Provides no long-term effectiveness. | Does not reduce contaminant toxicity, mobility, or volume through treatment. | Would not involve short-term physical disturbances. |
| 2 – LUCs | $794,000 | $582,000 O&M<br>$157,000 Periodic Costs (5-year reviews) | Successful implementation of this alternative requires proper documentation, communication of restrictions to Base personnel, compatibility with future land use and development plans, incorporation of restrictions with Base policy and permitting, regular inspections and continuous enforcement. | Does not reduce contaminant toxicity, mobility, or volume through treatment. | With the use of access restrictions, no short-term risks to the community or to workers would occur as a result of implementing this alternative. Similarly, no environmental impact from construction activities would occur. |
| 3 – Soil Removal | $2,076,000 | $0 | Attains long-term effectiveness and permanence because source material is removed from the site and placed in a facility specially designed, constructed, and monitored to receive such wastes. No monitoring or LUCs required. | Does not reduce contaminant toxicity, mobility, or volume through treatment. | Workers would be protected during implementation of this alternative with monitoring, personal protective equipment, and engineering controls to mitigate concerns about fugitive dust emissions and storm water management.<br>Transport of hazardous materials or regulated substances is not considered dangerous. |

| Alternative | Present-Worth Cost | Incremental Cost (if applicable) | Long-Term Effectiveness and Permanence | Reduction of Toxicity, Mobility or Volume Through Treatment | Short-Term Effectiveness |
|---|---|---|---|---|---|
| 4 – Physical Barriers | $5,794,000 | $2,918,000 O&M<br>$157,000 Periodic Costs (5-year reviews) | Attains long-term effectiveness and permanence because source material is placed underneath a soil cover, thereby reducing receptor exposure. Long-term monitoring and maintenance will be required to ensure the integrity of the soil cover.<br>As contaminated soil remains in place, LUCs will be required, as per Alternative 2. | Does not reduce contaminant toxicity, mobility, or volume through treatment. | Workers would be protected during implementation of this alternative with monitoring, personal protective equipment, and engineering controls to mitigate concerns about fugitive dust emissions and storm water management. |

Notes: Cost Effectiveness Summary:
(1) Alternatives 3 and 4 are not considered to be cost effective.
(2) Alternative 2 provides a good return on investment.

#### 2.13.1.4 Utilization of Permanent Solutions and Alternative Treatment Technologies

The selected alternative represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a cost-effective manner. Specifically, this alternative provides the best short- and long-term effectiveness, is protective of human health and the environment, complies with ARARs/TBCs, achieves RAOs, is technically feasible, and readily implementable.

#### 2.13.1.5 Preference for Treatment as a Principal Element

The NCP establishes the expectation that treatment will be used to address the principal threats posed by a site wherever practicable (40 CFR 300.430(a)(1)(iii)(A)). The selected remedy for Site 3 does not satisfy the statutory preference for treatment as a principal element of the remedy. A principal threat waste is source material with toxicity and mobility characteristics that combine to pose a potential risk greater than the risk level that is acceptable for the current or future exposure scenarios. As discussed in Section 2.11, there are no principal threat wastes at Site 3. Because there are no principal threat wastes, treatment is not considered necessary as a principal element of the final remedy for the site.

#### 2.13.1.6 Five-Year Review Requirements

Pursuant to CERCLA § 121(c) and NCP § 300.430(f)(5)(iii)(C), because the selected remedy will result in hazardous substances, pollutants, or contaminants remaining onsite above levels that allow for unlimited use and unrestricted exposure, a statutory review will be required within 5 years after initiation of the remedial action to verify that the remedy is, or will be, protective of human health and the environment. Changes in land use or exposure scenarios, or the potential for migration of contaminated soil from the site to offsite receptors will signify the initiation of an evaluation for alternative remedial action.

5-year reviews will be conducted until concentrations of hazardous substances, pollutants, or contaminants remaining onsite are reduced to levels that allow for unlimited use and unrestricted exposure.

### 2.13.2 Statutory Determinations, Site 21

#### 2.13.2.1 Protection of Human Health and the Environment

Alternative 2 provides protection of human health and the environment by removing the contaminated soil from the site. The proposed action reduces direct exposure to impacted soil, protecting both human and ecological receptors. Because contaminated soil is removed from the site and placed in a facility specially designed, constructed, and monitored to receive such wastes, the site will subsequently be available for unrestricted use. No monitoring, maintenance, nor LUCs are required.

#### 2.13.2.2 Compliance with ARARs

Remedial actions must comply with both Federal and State ARARs. ARARs are legally applicable or relevant and appropriate Federal and State requirements, standards, criteria, and limitations.

ARARs fall into three categories: contaminant-specific, location-specific, and action-specific. Contaminant-specific ARARs are health-based or risk-management-based numbers that provide concentration limits for the occurrence of a contaminant in the environment. Location-specific ARARs restrict activities in certain sensitive environments. Action-specific ARARs are activity-based or technology-based, and typically control remedial activities that generate hazardous wastes (such as with those covered under the RCRA). Offsite shipment, treatment, and disposal of excavated contaminated soil invoke action-specific ARARs. Criteria TBC are non-promulgated advisories or guidance issued by Federal or State governments that are not legally binding and do not have the status of potential ARARs. However, in many circumstances, TBCs are considered along with ARARs.

Table 2-24 summarizes the ARARs and TBCs for the selected remedy at Site 21 and describes how the selected remedy addresses each one.

The selected remedy complies with the contaminant-specific, location-specific, and action-specific ARARs. The implementation of the remedy is required to meet the substantive portions of these requirements and is exempt from administrative requirements such as permitting and notifications.

#### 2.13.2.3 Cost Effectiveness

In the judgment of the Navy, the selected remedy is cost-effective and represents a reasonable value for the money to be spent. In making this determination, the following definition was used: "A remedy shall be cost-effective if its costs are proportional to its overall effectiveness" (40 CFR 300.430(f)(1)(ii)(D)). This determination was accomplished by evaluating the "overall effectiveness" of those alternatives that satisfy the threshold criteria (that is, are protective of human health and the environment and ARAR-compliant).

Overall effectiveness was evaluated by assessing three of the five balancing criteria in combination: long-term effectiveness and permanence; reduction in toxicity, mobility, and volume through treatment; and short-term effectiveness. Overall effectiveness was then compared to costs to determine cost-effectiveness. The overall effectiveness of the selected remedy for Site 21 was demonstrated in the comparative analysis of alternatives (Section 2.10 – Summary of Comparative Analysis of Alternatives) and is summarized in Table 2-25. The estimated present worth cost of the selected remedy (in 2009 dollars) is $468,000.

#### 2.13.2.4 Utilization of Permanent Solutions and Alternative Treatment Technologies

The selected alternative represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a cost-effective manner. Specifically, this alternative provides the best short- and long-term effectiveness, is protective of human health and the environment, complies with ARARs/TBCs, achieves RAOs, is technically feasible, and readily implementable.

#### 2.13.2.5 Preference for Treatment as a Principal Element

The NCP establishes the expectation that treatment will be used to address the principal threats posed by a site wherever practicable (40 CFR 300.430(a)(1)(iii)(A)). The selected remedy for Site 21 does not satisfy the statutory preference for treatment as a principal element of the remedy. A principal threat waste is source material with toxicity and mobility characteristics that combine to pose a potential risk greater than the risk level that is acceptable for the current or future exposure scenarios. As discussed in Section 2.11, there are no principal threat wastes at Site 3. Because there are no principal threat wastes, treatment is not considered necessary as a principal element of the final remedy for the site.

#### 2.13.2.6 Five-Year Review Requirements

Pursuant to CERCLA § 121(c) and NCP § 300.430(f)(5)(iii)(C), because the selected remedy will not result in COCs, pollutants, or contaminants remaining on site above levels that allow for unlimited use and unrestricted exposure, statutory reviews will not be required.

## 2.14 Documentation of Significant Changes

The selected remedies described in this ROD for Sites 3 and 21 (and the preferred remedial alternative recommended in the PP) are protective of human health and the environment. No substantial changes have occurred in site conditions, land use, or regulations pertaining to remediation of these sites, since the issuance of the PP. No significant changes were made to the selected remedies recommended in the PP for Sites 3 and Site 21.

**Table 2-24: Description of ARARs and TBCs, Site 21**

| Type | Authority | Medium | Requirement | Status | Synopsis of Requirement | Action to be Taken to Attain Requirement |
|---|---|---|---|---|---|---|
| Contaminant-Specific | Federal Regulatory Requirement | Soil, Air and Groundwater | EPA Residential RSLs (EPA 2009) | TBC for COCs | RSLs combine current EPA toxicity values and standard exposure factors to estimate contaminant concentrations in environmental media that are protective of humans, including sensitive groups, over a lifetime. RSLs are generic criteria that can be used at all sites but do not consider natural background levels, ecological receptors, protection of groundwater, or all potential exposure pathways. The exposure pathways addressed in the development of RSLs include ingestion and inhalation of particulates, inhalation of volatiles, and dermal absorption. | The selected remedy will comply with this requirement by removing and properly disposing of soils with contaminant concentrations above RSLs. |
| Action-Specific | Federal Regulatory Requirement | Waste Stream | 40 CFR 262.11-Hazardous Waste Determination | Applicable Requirement | This regulation requires generators of solid waste to determine whether their waste is regulated as hazardous waste, according to 40 CFR 261. | Waste streams generated during the remedial action will be tested to determine whether they are RCRA hazardous and will be stored, transported, and disposed of accordingly.<br>Based on site investigation results, it is not anticipated that generated wastes will be found to be RCRA hazardous. |
| Action-Specific | Territorial Regulatory Requirement | Air | Guam Air Pollution Control Standards and Regulations, Section 1103.4 - Fugitive Dust | Applicable Requirement | This regulation prohibits visible fugitive dust from becoming airborne without taking reasonable precautions. | Onsite excavation and material handling can use precautions, such as water or contaminant suppression, covering trucks and roadway cleaning and maintenance to reduce fugitive dust emissions. |

| Type | Authority | Medium | Requirement | Status | Synopsis of Requirement | Action to be Taken to Attain Requirement |
|---|---|---|---|---|---|---|
| Action-Specific | Federal Regulatory Requirement | Air | 40 CFR 50.6 and 50.12 – Ambient Air Quality Standards Construction and excavation actions must comply with ambient air quality standards during excavation activities. | Applicable Requirement | Construction and excavation actions must comply with ambient air quality standards during excavation activities. | Dust emissions created from excavation activities must be monitored. Air pollution controls, such as dust suppression techniques, may be necessary to maintain air quality and keep particulate emissions to a minimum. Note that Guam air quality standards (GAPCSR, Section 1103.2 – Ambient Air Quality Standards) are not more stringent than the Federal air quality standards and therefore are not ARARs. |
| Location-Specific | Federal Regulatory Requirement | Soil | 16 U.S.C. 470 – National Historic Preservation Act Section 106 and 36 CFR Part 800 – Protection of Historic Properties | Not Applicable and Not Relevant and Appropriate | Section 106 and associated regulations require Federal agencies to take into account the effects of their actions on properties included in, or eligible for inclusion in, the National Register of Historic Places and, prior to approval of an undertaking, to afford the Advisory Council of Historic Preservation a reasonable opportunity to comment. | Not Applicable and Not Relevant and Appropriate. Nearest National Historic Preservation Site is Tarague (Talagi) Beach, located a 1.5 miles north of Site 21. |
| Location-Specific | Federal Regulatory Requirement | Soil | Archaeological Resources Protection Act of 1979 (16 U.S.C. 470ii) | Applicable Requirement | The Archaeological Resources Protection Act of 1979 is a Federal program mandating protection of any archaeological resources if discovered. | In the event that historic or prehistoric artifacts are uncovered during remedial activities, mitigation measures to protect the area would be required. Andersen AFB has developed an Archaeological Monitoring Plan for environmental projects and it would be implemented as appropriate. |

| Type | Authority | Medium | Requirement | Status | Synopsis of Requirement | Action to be Taken to Attain Requirement |
|---|---|---|---|---|---|---|
| Location-Specific | Territorial Regulatory Requirement | Soil | Guam Historic Preservation Regulations (21 Guam Code Annotated Chapter 76) | Applicable Requirement | Governs the identification, preservation, and protection of significant cultural resources in Guam. Establishes the State Register of Historic Places and assigns authority for implementing the National Historic Preservation Act to the State Historic Preservation Officer. | The State Historic Preservation Officer is responsible for managing significant national and State historic and archaeological resources within the territory of Guam. In the event that significant historic or archaeological resources within the meaning of these regulations are uncovered during remedial activities, mitigation measures to protect the area would be required, as discussed above with respect to 16 U.S.C. 470. |
| Location-Specific | Federal Regulatory Requirement | Biota | Endangered Species Act (16 U.S.C 1531 and 50 CFR 200, 402) and Fish and Wildlife Coordination Act (16 U.S.C 661 and CFR 320 to 330) | Applicable Requirement | The ESA is administered by two Federal agencies, the National Oceanic and Atmospheric Administration (marine species), and the USFWS (freshwater fish and all other species). This act protects species and also "the ecosystems upon which they depend." | The selected remedy will comply with this requirement by ensuring that no adverse impact to any endangered species or its habitat occurs. |

**Table 2-25: Cost and Effectiveness Summary for Site 21**

| Alternative | Present-Worth Cost | Incremental Cost (if applicable) | Long-Term Effectiveness and Permanence | Reduction of TMV Through Treatment | Short-Term Effectiveness |
|---|---|---|---|---|---|
| 1 – No Action | $0 | $0 | Provides no long-term effectiveness. | Does not reduce toxicity, mobility, and volume of contaminants through treatment. | Would not involve short-term physical disturbances. |
| 2 – Soil Removal | $468,000 | $0 | Attains long-term effectiveness and permanence because source material is removed from the site and placed in a facility specially designed, constructed, and monitored to receive such wastes. No LUCs are required. | Does not reduce toxicity, mobility, and volume of contaminants through treatment. | Workers would be protected during implementation with monitoring, personal protective equipment, and engineering controls to mitigate fugitive dust emissions and storm water management concerns.<br>Transport of hazardous materials or regulated substances is not considered dangerous; however, multiple modes of transport are involved, possibly elevating risks. |
| 3- Physical Barriers | $1,404,000 | $729,000 O&M<br>$157,000<br>Periodic Costs (5-year reviews) | Attains long-term effectiveness and permanence because source material is placed underneath a soil cover, thereby reducing receptor exposure. Long-term monitoring and maintenance will be required to ensure the integrity of the soil cover.<br>As contaminated soil remains in place, LUCs will be required. | Does not reduce toxicity, mobility, and volume of contaminants through treatment. | Workers would be protected during implementation of this alternative with monitoring, personal protective equipment, and engineering controls to mitigate concerns about fugitive dust emissions and storm water management. |

Notes: Cost Effectiveness Summary:
(1) Alternative 3 is not considered to be cost effective.
(2) Alternative 2 provides a good return on investment.

# 3.0 Responsiveness Summary

This section provides a summary of the public comments regarding the PP for remedial action at Site 3 and Site 21, Andersen AFB, Guam. At the time of the public review period, the Navy had selected Alternative 2: LUCs as the preferred alternative for Site 3, and Alternative 2: Soil Removal and Offsite Disposal as the preferred alternative for Site 21. No written comments were received on the PP.

## 3.1 Stakeholder Comments and Lead Agency Responses

Public comments were solicited during the public comment period and during the public meeting for the PP. The comment period was from 18 May to 17 June 2010 and the public meeting for the PP was held on 19 May 2010. A legal notice was published in the *Guam Pacific Daily News* newspaper on 4 May 2010 summarizing the PP and announcing the availability of the AR as well as the public comment period and public meeting. The public meeting was held at the Guam Marriott Resort and Spa in Tumon. The meeting was recorded and transcribed and is available in the AR. The transcript was reviewed to prepare this Responsiveness Summary. Responses to comments received from the public and community stakeholders in attendance at the public meeting are addressed in Appendix B.

## 3.2 Technical and Legal Issues

No technical or legal issues were identified during the public review period of the PP.

# 4.0 References


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# Appendix A
# Federal Facility Agreement Notice Letters

DEPARTMENT OF THE NAVY
COMMANDER, JOINT REGION MARIANAS
PSC 455, BOX 152
FPO AP 96540-1000

IN REPLY REFER TO:
9510
Ser J4/1235
November 23, 2009

Mr. Mark Ripperda
US Environmental Protection Agency
75 Hawthorne St. H-9-4
San Francisco, CA 94105-3901

Dear Mr. Ripperda,

SUBJECT: NOTIFICATION OF TRANSFER OF ENVIRONMENTAL RESTORATION PROGRAM RESPONSIBILITY

This letter serves as notification that all Environmental Restoration Program responsibilities for Andersen Air Force Base (AAFB), a property listed on the National Priorities List, will be officially transferred to the United States Navy under the Commander, Joint Region Marianas (CJRM), effective October 1, 2009, pursuant to chapter 2.17 of the April 2008 Department of Defense Environmental Supplemental Guidance (EVSG) for Implementing and Operating a Joint Base. This action is being taken to implement the 2005 Defense Base Realignment and Closure (BRAC) Act which requires the transfer of all installation support functions and administrative custody of real property from AAFB to the U.S. Navy.

In accordance with the EVSG, the Navy, as the supporting component, "will assume responsibility for environmental restoration data reporting, budgeting, record keeping, and financial liability" (Ch. 2.17.6), "will assume responsibility for all Restoration Advisory Boards" (Ch. 2.17.8), and will be required to "honor all existing, previously negotiated Federal Facility Agreements in place at the installations to become the Joint Base [Region] at the time of transfer." (Ch. 2.17.5).

If you have any questions, please contact Mr. Richard Raines, P.E., at telephone (671) 339-8420 or at richard.raines@fe.navy.mil.

Sincerely,

P. S. LYNCH
Captain, CEC, U.S. NAVY
Regional Engineer
By direction of the Commander

Copy to:
Guam Environmental Protection Agency
CNIC (N45)
NAVFAC Pacific (EV)
36CES

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS, 36TH WING (PACAF)
UNIT 14007, APO AP 96543-4007

06 November 2009

36 CES/CEVR
Unit 14007
APO AP 96543-4007

Mr. Mark Ripperda
Project Manager
U.S. Environmental Protection Agency
75 Hawthorne St., H-9-4
San Francisco, CA 94105-3901

Dear Mr. Ripperda

This letter provides notice of a change in administrative responsibility pursuant to paragraph 28 of Federal Facility Agreement (FFA) Docket Number 93-117 (FFA).

As you are aware, Andersen Air Force Base is in the process of realigning installation management functions to a newly established Joint Region Marianas pursuant to the 2005 Defense Base Closure and Realignment Commission Final and Approved Recommendations. Title to Andersen Air Force Base real property will remain in the United States and the property will continue to be utilized by the Air Force. As of October 1, 2009, however, administrative custody and responsibility for managing real property assets will transfer from the Air Force to the Navy. The Air Force will become a supported component of the Joint Region Marianas and the Navy will become the supporting component.

In accordance with the April 2008 Department of Defense Environmental Supplemental Guidance for Implementing and Operating a Joint Base, the Navy, as the supporting component, *"will be responsible for all existing and future environmental permits, requirements, plans, and agreements at the installations to become the Joint Base."* (Ch. 1.1.2). As the supporting component, the Navy will be required to *"honor all existing, previously negotiated Federal Facility Agreements in place at the installations to become the Joint Base at the time of transfer."* (Ch. 2.17.5). The Navy is being supplied with an Environmental Condition of Property Report and with access to current environmental files including the FFA. No change to the FFA will be necessary in order for the Navy to assume responsibility for implementation of the FFA and the transfer of responsibility will not change the rights of the parties under the FFA or impede any action under the FFA. The Environmental staff will remain located at Andersen Air Force Base following 01 October 2009 and will be available to assist with any issues related to the FFA. However, the civilian environmental staff will become Navy employees and, likewise, funding responsibility will reside with the Navy.

Please contact Mr. Russell Littlejohn, Environmental Flight Chief, at (671) 366-2556 if you have any questions or concerns or would like to discuss possible changes/addendums to the FFA to further document the substitution of the United States Navy for the United States Air Force as the entity responsible for implementation of the FFA.

Sincerely

GREGG IKEHARA
Chief, Installation Restoration Program

cc:
Ms. Lorilee Crisostomo, GEPA
Mr. Rich Howard, Tech Law Inc.

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS, 36TH WING (PACAF)
UNIT 14007, APO AP 96543-4007

06 November 2009

36 CES/CEVR
Unit 14007
APO AP 96543-4007

Ms. Lorilee Crisostomo
Project Manager
Guam Environmental Protection Agency
P.O. Box 22439 GMF
Barrigada, Guam 96921

Dear Ms. Crisostomo

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Sincerely

GREGG IKEHARA
Chief, Installation Restoration Program

cc:
Mr. Mark Ripperda, USEPA
Mr. Rich Howard, Tech Law Inc.